THE IRON TRADE REVIEW

VOLUME XXVI. CLEVELAND, O. MARCH 30, 1893. CHICAGO, ILL. NUMBER 13.

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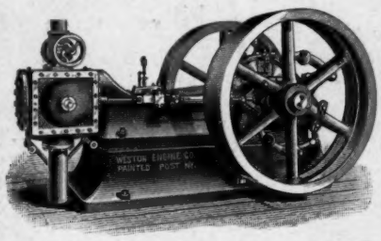

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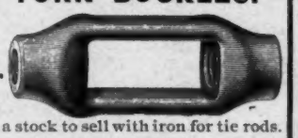

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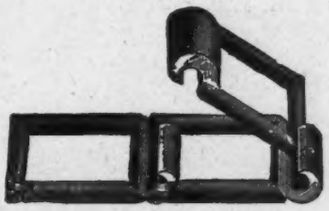

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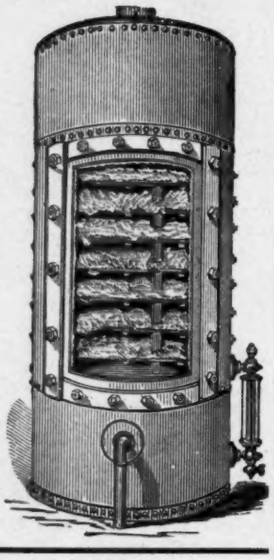

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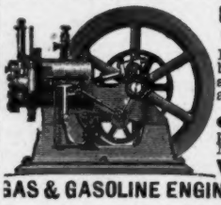

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THE IRON TRADE REVIEW

VOLUME XXVI. CLEVELAND, O. MARCH 30, 1893. CHICAGO, ILL. NUMBER 13.

THE WEEK IN IRON CIRCLES.

GENERAL FEATURES.

The price at which ores will be bought for the coming year, though not so uncertain a factor as it was a month ago, still keeps coming up in all figuring as to the course of the market in the next few months. The low prices Northern furnacemen have made since early December have cut off shipments of Southern iron in some of its wonted channels; and the prospect that presented itself a few weeks ago, of considerably lower ores than last year's, promised further sagging of prices in the competition between the sections. Yet there is an increasing tendency among furnacemen making iron for the general market in the district tributary to Lake Superior iron mines, to distribute purchases through the year. Thus the falling ore market has been followed closely by some furnace firms, and further reductions in pig iron by furnaces continued in operation, would be in large part contingent on concessions in the price of ore. It may be put down as almost a certainty that Bessemer ores will not be bought below the price at which sales have been made from the docks in the past winter. This presents the alternative of additions to the list of idle furnaces, or the maintenance of pig iron close to to-day's prices. The prospect that Bessemer pig iron will remain for some time close to the figures of the past two weeks is strengthening the billet market, and the indications are that advances will take place in finished steel—in structural material, plates and in merchant steel. The whole tenor of the Pittsburg market is more encouraging to steel makers, and the outlook is for a well maintained demand. There seems no prospect of betterment in forge iron; the present output is evidently in excess of consumption, while the reverse seems to be true of Bessemer. Eastern markets report that for standard grades of foundry iron quoted prices are being secured. Some Southern irons from smaller furnaces are being pressed upon the market at prices giving no profit. The large Southern producers affirm that there is only here and there a slight shading of $10.25, Birmingham, on No. 1 foundry, and some of them are refusing to make that concession. In general the maintenance of consumption by foundries and rolling mills is a surprise. There is without doubt a heavier demand than was the case a year ago, while furnace capacity is less. Foundries are feeling the effect of large locomotive and car contracts, and machinery construction is in increasing volume. Railroad construction in the West promises to be active the coming season, and the outlook is fully as encouraging as last year.

THE CLEVELAND SITUATION.

Further interviews between furnacemen and ore selling firms have followed the transactions reported last week, and some sales are on the point of consummation. There is not yet a general readiness to buy ore, although there is less and less expectation among furnacemen of getting their ore on any lower basis than that of $4 for standard Gogebic Bessemers, that being the price made in several transactions that might be specified. The theory on which some large producers of Bessemer ores are acting is that the figures at the opening of navigation will show, as far as Bessemer ores are concerned, that consumption the past year has been more than equal to the amount shipped from the mines; that it has taken in, also, a good part of the Bessemer surplus on the docks last spring. Furnacemen, in turn, are of opinion that the consumption of their Bessemer product is now in excess of production, and on that belief base the expectation that there will be no marked receding of present quotations. The promise of steel consumption in all lines would seem to bear out the prediction that the market will be a moderately firm one in the next few months. Billet-makers in Pittsburg and Wheeling districts are more completely sold up, and for a longer period ahead than in many months, so that the prospect of any weakening in products starting with Bessemer pig is exceedingly small. There are furnacemen who will run close to the end of their ore supply before navigation opens, and for some Bessemer mixtures it would be impossible to find any appreciable quantity of ore on the dock. The situation as to non-Bessemers—except in the case of a few grades that are so close to the limit, as to phosphorus, that they form a part of Bessemer mixtures—is still quite thoroughly in buyers' hands, and prices show considerable variation. There will undoubtedly be a larger stock of non-Bessemers on the docks when navigation opens than there was May 1, 1892. There went to furnaces in the winter of '91-2 from Lake docks 1,971,301 tons of ore. This record must be exceeded 640,962 tons or about one-third, in order that there may be no more ore on docks May 1, 1893, than was left May 1, 1892—that is, no more than 1,537,188 tons. While it is possible that more Bessemer ore has been shipped the past winter than in that of '91-'92, the same cannot be said as to non-Bessemer.

Pig Iron. With Bessemer iron held firmly at $14 to $14.25, Cleveland, there have been few transactions in the week. One sale is reported of a round lot for prompt delivery, but figures are withheld. Prominent sellers are still holding for $14.25, but with no local sales at that figure, as yet. Foundry iron gains no strength, and with sales at $14 for No. 1 reported a week ago, there is evidence of a slight shading of that price in the interval, one sale being reported at $13.90, Cleveland.

Finished Iron, etc. The improved outlook in raw steel has not made itself felt in finished lines, as yet. A 1,000-ton order for Eastern bridge work was placed locally within the week; the shapes for the same work went to the East. Car works are using freely of mill products, but there are few fresh transactions.

THE CHICAGO OUTLOOK.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

The market has been a very firm one, and the general feeling is one of confidence in the future. Without large sales, there have been a number of small ones aggregating a fair amount. In structural iron there is nothing new in view, outside of the large jobs already reported.

PIG IRON.—Though only a few orders of 1,000 tons or more have been placed, there has been a good run of smaller ones from carload lots to 100 and 200 tons. The stronger feeling of the Eastern markets has been duplicated in Chicago, and there is less cutting of prices. Local foundry, No. 1, holds the slight advance noted two weeks ago, and No. 2 has been selling slightly above $13. Lake Superior charcoal is quiet and firm.

BAR IRON.—Business has run in quiet channels, but the number of small orders has been quite satisfactory. Prices remain on basis 1.45c at mill. Soft steel bars are selling well in small quantities at 1.65c to 1.70c, Chicago.

BILLETS AND RODS.—As yet, the price of billets has not been affected by the advance in the Pittsburg market, and quotations remain at $25. Rods are unchanged at $32.50.

STRUCTURAL IRON.—Prices are firm and unchanged. Beams and channels, 1.90c to 2.10c; universal plates, 1.95c to 2.15c; sheared plates, 1.95c to 2.10c; angles, 1.95c to 2.10c; tees, 2.25c to 2.40c.

SHEETS.—Black sheets are selling fairly well, prices remaining at 2.85c. Galvanized sheets have had a very large sale, due to the improvement in the weather. Quotations are still at 70 and 7½ per cent. at the mills, and 65 and 10 per cent. to 70 per cent. from store.

PLATES, TUBES, ETC.—Sales are in fairly large quantities, with prices unchanged. Tank plates, 1.90c to 2.10c; shell steel, 2.20c to 2.30c; fire box steel, 3.75c to 4c; flange steel, 2.50c to 2.60c; tubes, discount of 62½ per cent.

MERCHANT STEEL.—Open-hearth spring, 2.35c to 2.40c; tire, 2c to 2.15c; machinery, 2.20c to 2.35c; crucible spring, 3.60c; machinery, 4.75c; tool steel, 6½c and upwards; Bessemer bars, 1.80c to 1.90c.

OLD RAILS AND WHEELS.—Very little business has been closed. On old rails we note an advance of 50c, to $18 50. Old wheels, remain at $14.50 to $14.75, and old steel rails at $11 for short lengths, and $14.50 for long.

GENERAL MARKET RESUME.

[SPECIALLY REPORTED FOR THE IRON TRADE REVIEW.]

Pittsburg. In the past ten days makers of Bessemer iron have enjoyed the novel and agreeable sensation of an advancing market. Consumers have purchased a fair volume in the week at prices ranging from $14 to $14.25. Local furnaces are holding firmly to $14 at furnace, or about $14.25 at buyer's mill. Transactions are few at the advance, since some buyers are not yet altogether persuaded that they have entered upon a period marked by an excess of consumption over production. This is the view of makers of Bessemer, however. Foundry and mill irons are not at all in sympathy with the rise in Bessemer and continue weak. Billet makers, even with Edgar Thomson back on billets, are predicting $24 in April, though $23.25 is the best price thus far. Mills are so well sold up that very few orders for round lots, prompt delivery, could be taken.

Cincinnati. The way in which demand for pig iron keeps up from foundries and mills, is a surprise, in view of the closeness of the money market and other conditions, not favorable to industrial development. Consumption of iron is thought to be larger than at this time last year, while production is less.

Louisville. There is more of a tendency to sell for deliveries throughout the year at present prices. Companies having interests in Alabama and Tennessee have come to the point of offering their iron from Tennessee furnaces on a lower basis delivered, than their Alabama iron, giving the buyer the benefit of the difference in freight. Grey forge is sold on the basis of $8 at furnace, but not lower. On No. 1 foundry $10.25 at furnace has been shaded by some furnaces.

A WESTERN FOUNDRYMEN'S ASSOCIATION.

BY THOS. D. WEST.

In answer to the question whether I believe there is a field for an association to discuss questions of interest and to afford protection to foundrymen, to be established in the West similar to that in the East, I would say there decidedly is. In fact, it is required more West than East, as competition is much sharper and prices are lower, so much so that firms East buy castings of the West. Foundrymen of the West can afford to sell some cheaper than those of the East; for, as a general thing, the latter take more time with work and have better-schooled moulders, hence turn out a better product, but not to the degree that prices differ. With what little time I have had to study the subject, I must say I have not as yet conceived of any plan that to my idea would be practical, for the regulation of prices; nevertheless, I think there are other ways in which such an organization can be of benefit to its members. One of these I will take the liberty to cite:

It strikes me as a very practical thing for such an organization to issue a monthly report, something after the character of our mercantile agency reports, in which designing, unscrupulous purchasers and manufacturers could be reported, and their characters fully shown. It is astonishing the tactics and unreasonable measures some practice in taking advantage of competition, letting out contracts, and accepting castings. Go into their works to figure, and seldom will you be shown the intricate and objectionable features of their work. You will be taken up to some machine and told, "There it is; now what will you make it for?" The proprietor will not say: "This piece previous foundrymen had to cast dozens of times, to get accceptable castings, and for that piece we have not got a full pattern, but use a skeleton or a sweep to make it," or that the patterns are not worth a cent as far as good finish, taper and design are concerned. You simply take his word that they are all O. K., and he padlocks you by getting off that settler, "Others have made and are making the castings from them." You take the job and generally find that had you known just the conditions, you would have put in a higher bid, or let the work go by the board.

And, again, another point which presents itself is the unjust discrimination often made in accepting castings; and such actions are particularly characteristic of those that know little or nothing about the chances and difficulties attending the production of *absolutely perfect work*. In most every city firms can be found that have defrauded nearly every foundry in the place, and some have gone so far as to be compelled to go out of their city to get their work done, and defraud others as a foundry once having worked for them will never do so again. There are dozens of cases I could cite, in which foundrymen have been unjustly dealt with, and often have I felt and been forced to stand idly by and see the lash of competition nearly ruin some foundry, struggling for an existence, simply through misrepresentation, bad, incomplete patterns and unjust discrimination in accepting castings. It is high time foundrymen were coming together for self-protection, and to assist in the work you can count on me as one, and would volunteer a paper on other points from which such an organization could derive benefit.

SHARPSVILLE, PA., March 21, 1893.

H. W. KNIGHT & SON, of Seneca Falls, N. Y., makers of pattern letters, brass letters, pew plates, etc., are just completing a contract for brass letters, in which they excel, and are turning out large quantities of pattern letters for foundrymen's use.

THE IRON TRADE REVIEW

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MARCH 30, 1893.

NOT only editorial, but regular news features are compressed for this issue of *The Iron Trade Review* to give place to a number of interesting articles which will be found in other columns. The discussion by Mr. Pechin of the fuel problem involved in the proposition to build coke blast furnaces, near the Lake Superior ore supplies, is continued most interestingly, and to-day's article will be finished in the issue of next week. Mr. Richard A. Parker masses statistics to support his belief that the Northwest is to furnish a goodly share of the blast furnace capacity needed to produce the 6,000,000 additional tons of pig iron which statisticians predict will be required by this country in 1900. Mr. Bolland's article on "Core-Making," Mr. West's letter pointing out a field for a Western Foundrymen's Association, Mr. Larsson's paper on "Soft Ore Mining," read before the Lake Superior Mining Institute, last week, and the summation of Chicago's extensive interests, are all features of this impression that will have a careful reading.

THE jealousy and mutual distrust of sharply competing manufacturers and the fear that there may be an unequal distribution of advantages in the new deal, are the chief obstacles encountered in efforts to bring about industrial combinations. The cast iron pipe manufacturers have spent months in the attempt to get together, which is now on the eve of success, and the result is in large measure due to the efforts of gentlemen outside the business, who represented the New York capital that is to take stock in the American Pipe & Foundry Co. Mr. O. C. Barber, of Chicago, and attorney F. M. Atterholt, of Akron, who performed a like office in the organization of the Diamond Match Co., the American Strawboard Co., the American Crayon Co., the American Fire Extinguisher Co., and the combination of plate glass manufacturers, have been prominent in bringing the inharmonious elements together. The concentrating tendencies of the time have created this special line of expert service that promises to develop into a profession, if the present pace toward Bellamy's all-absorbing combine is maintained.

MR. THOMAS D. WEST adds another to the growing list of seconds to the proposition for a Western Foundrymen's Association, and what is much to the point, promises the aid of his pen. That means one valuable paper for the initial meeting.

LAKE COKE-MAKING.

AND THE WEATHERING OF CONNELLSVILLE COAL.

BY EDMUND C. PECHIN.

On returning after a two months' absence from the country, I find among my mail inquiries from friends, and newspaper comments, on the subject of my statement in your issue of Dec. 22nd last, that reliable coke could not be made out of Connellsville coal stocked at Lake Superior. Disliking a discussion of this sort in the public prints, I can very plainly now see that unintentionally I have invited it. Furthermore, the temperate and courteous articles of Mr. Richard A. Parker in your issues of Feb. 9 and March 9, indicating as they do no spirit of captious criticism, but rather a desire for further light on the subject, leave me no alternative but to attempt to justify the position assumed. This justification may compel me to be somewhat prolix, for which I must ask the forbearance of your readers. One word of a personal nature: On Feb. 9, Mr. Parker says: "In the person of Mr. E. C. Pechin of your city, the opponents of its success [coke-making at Lake Superior] have had a champion." I must be permitted to say that, at the time I wrote, I was absolutely ignorant that any such contest had been going on, and I had not seen one word concerning it in any public or private paper. Still further, I want to say, with the most pronounced emphasis, there is nothing of more importance to the interests of the Northwest than that coke-making, in close proximity to the great iron ore deposits of Lake Superior, should be made an early and unqualified success, and that Mr. Parker and his co-adjutors should be assisted in every possible way.

WHY COKE CANNOT WELL BE HAULED.

The long all-rail haul from the coke fields of Pennsylvania and West Virginia to the Superior region is a serious obstacle, in these days of low iron prices. It is scarcely a commercial possibility to take coke to a lower lake port for carriage by water the balance of the way. Its very great bulk, as compared with its weight, the difficulty of handling it out of the cars into the vessel, and the still greater difficulty and expense in unloading from a vessel at its destination, would seemingly bar this method of transportation, irrespective of the disadvantage and loss necessarily resulting from the breaking up and wasting of the coke. The problem to be solved is, to get a coal that will bear stocking, *and at all times and under all circumstances* make a reliable coke.

As to what constitutes the coking power of coals, and the effect of weathering upon them, not very much is definitely known, and it is an all important and most interesting field for full, patient and intelligent investigation. The position to be taken in this paper is, that what is known as Connellsville is not the coal to be carried to a distance, stocked, and then made into a commercial coke; and by this is meant, a standard coke, month in and month out. A cupola melting limited quantities and at intervals can stand, without much loss, an occasionally irregular fuel; but a modern blast furnace is too gigantic and sensitive and costly a machine to trifle with in the slightest. A burden giving the most satisfactory product and results on a good coke, by a sudden change in the character of the fuel may give results that will sicken the stoutest heart and purse. That first-class coke has been and may be made out of stocked Connellsville coal, is admitted; but that this can be done steadily, is not. The opinion given by Mr. John Fulton, whom we all recognize as a master, is entitled to such weight that I approach the subject with great diffidence, but hoping nevertheless that what may be said will receive not his adverse criticism, but his approval.

The attention of those interested in the critical examination of the weathering of coals is called to the following: The remarks of Prof. Jno. W. Langley at the Pittsburg meeting, 1872, Transactions of American Institute of Mining Engineers, Vol. I., page 286; papers of Mr. Richard P. Rothwell at New York, 1874, Vol. II., p. 151, and at Dover, 1875, Vol. IV., pp. 61-64; the very full paper of Dr. James F. Kimball at Pittsburg, 1879, Vol. VIII., p. 204, and to Vol. M. M. 2d Pennsylvania Geological Survey, p. 120. These papers contain a summary of investigations of the subject the world over. Extracts will be made from the above for the benefit of the general reader.

WHAT IS WEATHERING?

"By the term weathering of coal is meant the process of deterioration to which, under various circumstances, it may be exposed at ordinary temperatures, both from outward agencies, on the one hand, and on the other hand, from its own constitutional qualities. * * The weathering of coal involves a loss of calorific carbon and hydrogen, and a corresponding gain of non-calorific carbonic acid and water."

The weathering oxidation of coal is the result of separate, but closely related phenomena, the effects of which it may be well to here distinguish as follows: 1. The invisible effect of the oxidation of its organic constituents. 2. The more or less visible effects of the oxidation of its accessory pyritic contents.*

Mr. John Fulton, speaking of the Cambria coal, says: "At best it is rather dry. In the mine from which the coke ovens are supplied, I am drawing back coal pillars that have been standing for two or three years. When the drawing began, our coker detected the trouble at once; his coke would not 'stick' and his ovens got cold. I had to open a new section of the mine, so as to mix fresh coal with the weathered coal pillars." †

Nearly seventeen years ago, when I was mining and coking coal in one of the *very best* sections of the Connellsville field, I had a precisely similar experience. In drawing pillars, less than two years old, far back from the pit opening, it was impossible to make good coke from this coal without mixing fresh room coal with it. This incident first called my attention to the weathering of Connellsville coal, which in this instance, was brought about simply by atmospheric influences. There is a very marked difference in the composition of the above two coals, the Cambria having only 16.5 per cent. volatile matter, as against over 30 per cent. in Connellsville; 74.4 per cent. fixed carbon, as against 59.6 per cent.; 5.9 per cent of ash, as against 8.2 per cent., and 1.86 per cent. sulphur, as against .78 per cent.‡

McCreath says: "The difference in the *percentage* of *volatile matters* being insufficient to account for any change in its coking qualities, it would seem as if the deterioration must either be due to an alteration in the physical structure of the coal, or to a difference in the chemical composition of the volatile matter." §

WHAT CAUSES WEATHERING.

Under given conditions weathering may proceed with great rapidity—or more slowly and is superinduced by, first, the tendency of a coal to absorb oxygen; second, the presence of pyrites; third, the conditions of dryness or moisture. Time does not permit the looking up of authorities, but my recollection is that Connellsvile coal absorbs oxygen with great rapidity. Apart from any chemical tests, its behavior when exposed to the air indicates this. A freshly mined lump will desintegrate after a short exposure, and Kimball says: "If, as appears probable, physical disintegration of coal may be taken as some measure of the extent of oxidation of essential portions, a reduction of coking power would be a practical result, even where the small division of coal would be no detriment." ‖

"According to Dr. Richters, the weather waste of a coal depends on its ability to absorb oxygen converting the hydrocarbons into water and carbonic acid. * * Grundman states that the decomposition takes place in the middle of a heap, the same as on the surface, and it reached its maximum about the third or fourth week. * * He also found that a coal poor in oxygen absorbs it most rapidly, and that the presence of moisture is an important condition. Varrentrapp, of Brunswick, found in his experiments, that oxidation of the coal takes place even at a common temperature when moisture is present. * * It is nevertheless quite certain that most varieties of bituminous coal deteriorate very rapidly and to an extent but little appreciated." ¶

"Freshly won coals were observed by Richters to absorb oxygen at first with great rapidity. The oxidation of coal was proved to be accelerated by elevation of temperature, and a moderate temperature long continued to produce the same effects as a higher temperature for a shorter period. * * Assuming the physical absorption and condensation of oxygen preliminary to oxidation of the organic parts of the coal, Richters attributes elevation of temperature in masses of certain coals under favorable circumstances chiefly to the heat developed by both processes of absorption. Hence coals possessing the highest power of absorption are those which oxidize most rapidly and evolve the greatest amount of heat, and this under favorable circumstances exhibit the maximum effect of weathering. * * Circumstances especially favorable for the production of such effects, are (1) a porous condition of the coal or a state of small division, and (2) the accumulation of coal under such conditions as to prevent radiation of heat, as when stored in confined spaces or in large heaps."*

"Many varieties of coals deteriorate to a great extent when exposed to the air and this deterioration is greatly favored by high temperatures, and in coals which contain sulphurets of iron by moisture. In coals free from iron pyrites, this oxidation seems to be even more energetic when dry than when wet, and is more energetic when the coal is in dust or slack. In the case of coking and gas coals the depreciation in the heating power and in the coking and gas producing properties, is very great."†

McCreath says "the famous coking coal from the Connellsville district seems to have suffered quite an appreciable loss in volatile matter, and the coking qualities of this coal have been materially impaired, although not to any great extent."‡ This opinion seems rather paradoxical. It is proper to say in this connection, that the only analyses given by McCreath are of coals with an interval of a year elapsing, and if it can be shown that impairment only takes place after this lapse of time, many practical objections would disappear.

Quotations bearing on the subject could be given *at libitum*, but surely enough has been said on this point.

SECOND AND THIRD.—PYRITES AND MOISTURE.

On this topic, it is not necessary to trouble the reader with any opinions or extracts, because it is universally conceded that pyrites in coal, with moisture added, produces a combustion most detrimental to the coal. The whole subject is exhaustively treated not only in the papers above given, but also in another paper by Dr. Kimball entitled "Relations of Sulphur in Coal and Coke" in Vol. VIII, p. 181. A single extract as to its physical action: "The mechanical results of pyritic oxidation in effecting disintegration and comminution of the coal, cannot fail to be recognized as among the most favorable conditions of weathering action, by increasing the perviousness of the coal and hastening its oxidation." §

The important query is, has the Connellsville coal any sulphur present capable of doing serious damage?

Both the Connellsville coal and coke are especially commended to the trade, and in the main justly so, on account of their comparative freedom from this objectionable element. To show what an expert's opinion is on so-called first-class coal, I must again quote from Mr. Fulton: "The most impressive fact in the whole washing process is the *unexpectedly large* quantity of slate and impurities in *coal of good quality*. The old legend of coal 'absolutely free from slates and sulphur,' has been hopelessly ruined in the pile of slates and pyrites at a coal washer, burying it out of sight in total oblivion."

While it all passes under one general name, there is a vast difference in the coal coming from different sections of the Connellsville field, as is well known to every one who has worked in it, whether he is willing to admit it or not. In some sections the slate partings are infinitesimal and there the coal and resultant coke are best. In other sections, the slate partings are numerous, decidedly increasing as you go north, until the northern end of the basin is reached, where the coal is found so full of slate and impurities, as to render the coke made from it worthless, unless the coal be first carefully washed. As a rule, the pyrites follow the slate partings. I have seen many analyses of so-called Connellsville coke properly sampled that ware surprisingly high in sulphur.

I vividly recall a business incident when I was directly in the iron trade. As is well known, in the not so long ago, if a foundry made bad castings it was always laid to the fault of the iron, particularly if the price were falling. The usual complaint was made that a melting had been spoiled at a heavy loss, and all owing to poor hard iron. I knew the iron thoroughly, and that it was a first-class soft foundry. Upon investigation I found that the regular coke supply had been interrupted, and the founder had gone on the open market for a car load of Connellsville coke. An analysis being made, it was rotten with sulphur, which, of course, had ruined the melting, giving hard and worthless castings. He did not get any reduction in his iron, but he did get what I think was of more value, a suggestion as to what part of the Connellsville field he should draw his supplies from. [To be concluded April 6.]

*Vol. VIII, p. 204-5. †M. M. p. 120. ‡M. M., p. 122. §Ibid, p. 122. ‖Vol. VIII, p. 213. ¶Vol. II, pp. 151-2.

* Vol. VIII, p. 209-211. †Vol. IV, p. 64. ‡M. M. p. 120-122. §Vol. VIII, p. 212. ‖Vol. III, p. 181.

UPPER LAKE FURNACES.

MARQUETTE AS A PIG IRON PRODUCER.

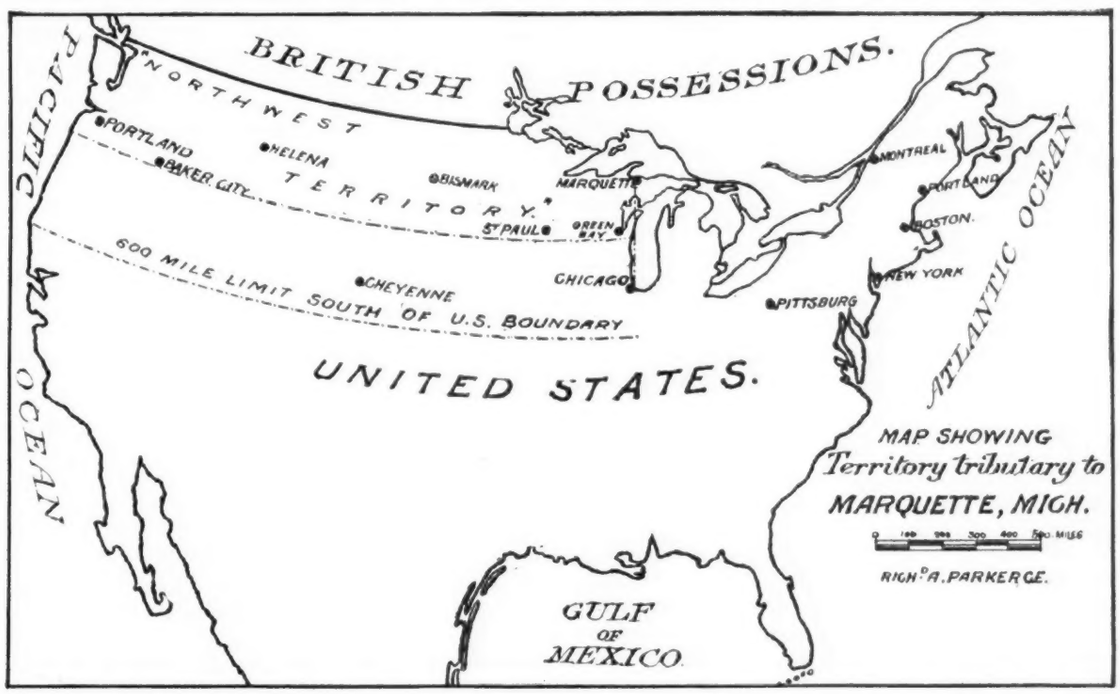
With the Great Northwest as Its Market—A Field Waiting to be Occupied.

BY RICHARD A. PARKER.

Having in previous letters* brought forward evidence tending to show that raw material can be assembled at this port for the economical production of pig iron (by having the various iron ore mines within twenty miles of an excellent furnace site, and fuel in the form of coal for coking to be had at a cost comparable to that paid at Chicago, Ills.), it will be my effort, in this last letter, to show that, by reason of its geographical position, Marquette is well located to command the markets of the Northwest; and, finally, that there must be provided, within a very few years, additional furnace capacity to yield the pig iron needed for a consumption that is rapidly increasing.

THE TRAFFIC BELT SPANNED BY THE LAKES.

If we look at a map of the United States, we see that the Great Lakes occupy a position midway between the oceans and form a portion of the northern boundary between the



States and Canada. They hold a paradoxical position, inasmuch as they are the means of promoting internal commerce to a wonderful extent, and at the same time they act as a wall or barrier for through east or west bound freight, compelling a portion of the freight from the Northwest to pass down and around the south end of Lake Michigan. It is unquestioned that the great mass of moving freight from one ocean to the other is confined to a belt of territory not exceeding six hundred miles in a northerly and southerly direction. It may be remarked that the distance from the north shore of Lake Superior to the southern end of Lake Michigan is about five hundred miles. Within the six-hundred-mile belt above referred to—that is, from the Canadian boundary, on the north, to a point one hundred miles south of Chicago, Ill.—is practically embraced the northern half of the United States. It takes in the Eastern States, New York, Pennsylvania, the northern half of Ohio, Indiana and Illinois, two-thirds of Wisconsin, all of Michigan, Minnesota, Iowa, Kansas, North Dakota and one-half of South Dakota, the northern third of Missouri and Wyoming, all of Idaho, Montana, Oregon and Washington, together with small fractions of California, Nevada, Utah and Colorado. In addition to all these, there will be available the most fertile and inhabitable portions of Manitoba, Northwest Territory and British Columbia. These states contain by far the largest number and most important manufactories in this country, and the Western States are equally prolific in their output of agricultural products; so that between the two there is a stream of ever-moving freight of manufactured material to be exchanged for the cereal and other soil products of the West.

These streams of freight will follow natural laws and flow in the easiest course to their destination, avoiding obstacles and following the line of least resistance. East bound freight will follow its course until it strikes Lakes Superior or Michigan, and its future course (that is, north or south of Lake Michigan) will depend upon its destination, and also its locus when it is necessary to decide whether to go to the north or south of the lake. It may be assumed that, other things being equal, freight will pass to the north of the lake that originates north of a line midway between Marquette and Chicago. This line is shown upon the map, and passes through Manistee, Mich., Red Wing, Minn., Pierre, S. D., and Baker City, Ore. The freight of this territory then may be considered as belonging to Marquette rather than to Chicago, and, therefore, the growth of this country in its railroads, cities and other demands for iron in its varied forms, also properly belongs to this northern territory to supply. In area it amounts to a strip of land about three hundred miles wide and eighteen hundred miles long, or 540,000 square miles; this amounts to *seventeen and eight-tenths per cent. of the total area of the United States*, exclusive of Alaska, of which no account has been taken, but which, as its resources become better known, will be developed and add its quota to the increasing call for iron and steel products.

SHORTEST HAUL THROUGH THE UPPER PENINSULA.

If a line be drawn from the south end of Lake Simcoe (in Ontario, southeast of Georgian Bay) easterly to Boston, Mass., it would mark the southern limit from which the territory west of the lakes can be reached by a shorter haul via the Upper Peninsula of Michigan than by any lines running south of Lake Michigan. This would include all of the States of Maine, Vermont, New Hampshire, one-third of New York, one-quarter of Massachusetts, all of the Canadian provinces of Nova Scotia, New Brunswick, Quebec, and about one-fourth of Ontario. The commerce of the North Atlantic seaboard, from Boston north to the Gulf of St. Lawrence, can reach the west and northwest by passing between Lake Superior and Lake Michigan, with a shorter haul than by any other route.

By lines of railroad already constructed, the difference in the distances between New York and the southern shore of Lake Michigan (Chicago), and New York and Marquette is only 66 miles, taking the Pennsylvania Railroad Co.'s mileage at 912.

From Montreal to Marquette, in an air line, is 670 miles,

*See issues *The Iron Trade Review*, February 16 and March 9, 1893.

while by rail it is 780 miles. This shows that the seaboard can be reached by a shorter haul from Marquette than from Chicago. From Marquette to New York City, by the shortest existing railroad lines, is 1,045 miles. From Chicago to New York via the Lake Shore road is 979 miles, being a difference, as stated, of only 66 miles; and if a trunk line were established, it is quite fair to assume that all of this difference could be eliminated, by a consolidation of small railroads. All of these figures go to show that practically there is but little difference between the length of haul from Marquette to New York and that from Chicago to New York.

RAPID GROWTH OF THE LAKE REGION.

In order that the value and importance of the area controlled by and tributary to Marquette may be fully appreciated, a reference to the statistics of the late census will give an idea of the wonderful growth and increasing importance of that territory. In the Canadian provinces west of Lake Superior, comprising an area of about 320,000 square miles, the increase in population for the last decade showed an average in the several provinces of one hundred and twenty-six per cent.

In the Northwest Territory of the United States, that is, the strip of land 300 miles wide by 1,800 miles long, the increase in population in 1880 over that of 1870 was fifty-five per cent., and the increase in 1890 over the population of 1880 was over sixty per cent.

In the Upper Peninsula of Michigan the increase was from 85,030 inhabitants in 1880 to 180,523 in 1890, or an increase of one hundred and twelve per cent. The average increase of assessed valuation shows a gain of nearly three hundred and thirty per cent. for the entire area under discussion. In 1880 this area had three and one-third inhabitants to each square mile; in 1890 the gain amounted to five and one-half inhabitants. The average number of inhabitants for each square mile of the United States, for the census year 1890, was 20 43-100, excluding Alaska. Should this "Northwest Territory" achieve the average population of the United States for each square mile, it will contain about 23,000,000 people, and should the same rate of increase continue for the next three decades, that has obtained in the past one, then this area will contain a population of, say 10,000,000 in 1900; 16,000,000 in 1910, and 26,000,000 in 1920.

THE NORTHWEST'S RAILROAD GROWTH.

In railway building, the figures that are presented in Table I show the advance of this section, and when it is remembered that every mile of railroad calls for about one hundred tons of iron, and that this area built over twenty per cent. of all the railways built in the United States between 1880 and 1890, it will be seen what the possibilities in this one direction are, and why new sites for obtaining the needed pig metal are absolutely called for.

The railways of the United States in 1890 amounted to 166,817 miles, while in 1880 the total was 93,837 miles, showing an increase of nearly 73,000 miles of road. The railways now laid have consumed over 2,500,000 tons of steel, and call annually for 250,000 tons of iron or steel for repairs, renewals, etc., this amount not including the metal necessary for rolling stock, bridges, etc.

Taking the same periods of time as in the discussion of the railway mileage of this Northwest Territory, and taking the proportion of total output of the state, that the area included in this territory bears to the State, we find that the increase in agricultural products has kept pace with the wonderful growth in its several other directions. For instance, without going into detail here, we find that the totals of the crops of this section in the last three census years were as follows:

In 1870, 135,037,358 bushels.

In 1880, 248,761,247 bushels, increase over 1870 of 85 per cent.

In 1890, 440,749,767 bushels, increase over 1880 of 75 per cent.

These consisted mainly of the cereals, wheat, Indian corn, rye, oats, barley and buckwheat:—This increase in actual tonnage was 4,800,000 tons; to move this amount of food product alone, would require 320,000 cars of 15 tons each, or 8,000 trains of 40 cars to a train: if one 40-car train was loaded and dispatched every hour, it would take very nearly a year (333 days) to move this *increase*.

From the foregoing, it is evident that a vast amount of business lies in this great and wonderfully growing Northwest Territory, and its wants and needs in iron and steel must be met—and met by those best able to enter the field and hold it.

PIG IRON PRODUCTION AND POPULATION.

It is universally admitted that the growth of a nation is evidenced by its iron and steel output, and that the consumption of that metal is proof of its prosperity: the demand for iron has usually kept pace with the increase of population in this country, but eminent statisticians have proven conclusively that the rate of consumption in this country at least, is an accelerating one and one that has passed the rate of increase of population.

In a paper read before the joint meeting of the British Iron and Steel Institute and the American Institute of Mining Engineers, in October, 1890, by Hon. Abram S. Hewitt, president of the Institute, the following table (II.) was presented, showing the comparative rate of increase in population and pig iron production in the United States for six decades.

"This table," the writer says, "brings out the striking conclusion that the production of pig iron has always increased

TABLE I.—*Memoranda of Railway Mileage in the "Northwest Territory."*

State.	Proportion included.	Proportion of Track in State. 1890.	1870.	1880.	1890.	Square Miles Per mile of track.
Wisconsin	Two-thirds.	One-half.	150	1,375	2,790	9.66
S. Dakota	One-half.	One-half.	See N. Dakota.	See N. Dakota.	1,988	36.35
Wyoming	One-third.	One-tenth.	0	0	95	103.92
Nevada	One-fourth.	One-eighth.	0	100	116	121.10
California	One fourth.	One-third.	0	90	1,452	36.23
Minnesota	All.	All.	1,092	3,151	5,545	15.28
N. Dakota	All.	Incl. S. Dakota.	65	1,225	2,116	36.69
Montana	All.	All.	0	106	2,195	65.93
Idaho	All.	All.	0	206	946	91.65
Washington	All.	All.	0	289	2,004	39.25
Oregon	All.	All.	159	500	1,455	66.72
Michigan	Upper Pen.		100	426	1,247	7.79
Total			1,566	7,476	21,949	51.20

Increase in decade 1870 to 1880—300 + per cent.
Increase in decade 1880 to 1890—200 + per cent.

TABLE III.—*Distribution of Population and Production of Pig Iron, according to Census Returns of* 1860, 1870, 1880 *and* 1890

	1860. Population.	1860. Production of pig iron.	1860. Inhabitants per ton of pig iron.	1870. Population	1870. Production of pig iron.	1870. Inhabitants per ton of pig iron.	1880. Population.	1880. Production of pig iron	1880. Inhabitants. per ton of pig iron.	1890. Population.	1890. Production of pig iron.	1890. Inhabitants per ton of pig iron.
New England States	3,135,283	26,600	117.87	3,487,924	30,778	113.33	4,010,529	27,640	145.10	4,700,745	30,162	155.85
Percentage	9.97	2.69		9.05	1.68		8.	.82		7.51	.35	
Middle States	7,571,201	706,369	10.72	8,935,821	1,171,115	7.63	10,643,486	2,143,833	4.96	12,869,293	4,657,670	2.76
Percentage	24.08	71.53		23.17	63.89		21.22	63.50		20.55	54.46	
Southern States	9,981,480	100,761	89.06	10,859,955	164,768	65.91	13,975,686	311,639	44.95	16,236,784	1,582,106	10.26
Percentage	31.74	10.20		29.16	8.99		27.86	9.23		25.93	18.50	
Western States	10,755,357	153,829	69.92	15,274,671	466,215	32.76	21,526,032	892,799	24.11	28,815,428	2,283,436	12.62
Percentage	34.21	15.58		39.62	25.44		42.92	26.45		46.01	26.70	
United States	31,443,321	987,559	31.84	38,558,371	1,832,876	21.04	50,155,783	3,375,911	14.86	62,622,250	8,553,374	7.32
Pennsylvania	2,906,215	580,049	5.01	3,521,951	922,564	3.82	4,282,891	1,723,492	2.48	5,258,014	4,207,559	1.25
Percentage	9.24	58.74		9.13	50.33		8.54	51.06		8.40	49.19	

NOTE.—The figures in the lines of "Percentages" represent the percentages of the total population (or product, as the case may be,) of the United States.

more rapidly than the population and that the ratio is an increasing one. Between 1830 and 1860 the production of iron increased twice as fast as the population. Between 1860 and 1890 it increased four times as rapidly, in reality over four times, thus proving that the national wealth continues to grow from decade to decade, at a rate of acceleration of which the world affords no previous example. Inasmuch as during all this time, we have imported iron in addition to our production, it follows that the consumption per capita has also increased more rapidly than population. In 1855, according to careful calculations, which I made at that time, we were consuming

TABLE II.—*Relative Increase of Population and Pig Iron Production in the United States.*

Year.	Production of pig iron. Gross tons.	Rate of increase. Per cent.	Population.	Rate of increase.
1830	165,000	.....	12,866,020	32.51
1840	315,000	91	17,069,453	33.52
1850	564,000	79	23,191,876	35.83
1860	821,223	46	31,443,321	35.11
1870	1,696,429	106	38,558,371	22.63
1880	3,835,191	126	50,155,783	30.08
1890	9,202,703	140	62,622,250	24.86

iron at the rate of 117 pounds per head; whereas, in 1890, the consumption has increased to rather more than 300 pounds per head, the whole of which, for the first time in our history we are producing within our own borders. Great Britain, on the other hand, produces more iron than it consumes, and is still the largest per capita producer in the world. In 1889, with a production of 9,321,563 tons of 2,000 lbs., and with a population estimated at 38,000,000, the production reached the large figure of 495 pounds per head. Deducting the exports Great Britain is now consuming 250 pounds per head against a consumption of 144 pounds in 1855. But the production of iron in Great Britain appears to be now very nearly stationary."

It will be seen that Mr. Hewitt fully believed in the wonderful devolopment of the iron industry, for he then said: "I think it is safe to estimate, therefore, that in 1900, the world will require 35,000,000 gross tons of iron, of which the United States must supply 45 per cent., and the other iron producing contries the remainder, in the proportion of half to Great Britain, and half to Germany, France, Belgium and the other smaller producers. This means that the production of pig iron for the year 1900, in the United, will probably amount to 15,750,000 gross tons.

In his treatise on the "Future Situs of the Principal Iron Production of the World," Mr. Edward Atkinson presents an estimate concerning the probable demand of the world for pig iron in 1900, which is in sharp contrast to the conservative figures given us by the great iron-master above quoted:

Edward Atkinson's Estimate.

	Tons.	Tons.
Present production		25,000,000
Increased consumption in the United States	7,000,000	
Increased consumption in Great Britain, Germany and Belgium	2,000,000	
Increased consumption in all the rest of the world	6,000,000	
Total increase of demand		15,000,000
Total supply required		40,000,000

He says: "If, then, one may predict a continuance of this law of accelerating demand for the next eleven years, neither 40,000,000 nor 44,000,000 gross tons will suffice in the year 1900. If this increasing demand should continue, the supply must be 100 per cent. in excess of that which now prevails. The supply in 1900 must be 50,000,000 gross tons or 56,000,000 net tons. Who will supply it?"

Within the past decade we have seen the birth and wonderful advancement of a new section of the United States, which has served to place one of the Southern States third in the list of iron producers, whereas in the previous census year 1880, the amount of iron produced by it was insignificant. Alabama in the year 1890 produced 914,940 net tons of iron, which is nearly three times the amount of iron made in all of the Southern States combined in the census year 1880.

THE SOUTH'S RECORD MUST BE DUPLICATED.

Such phenomenal growths are essential to the scheme of increased production, and it will be necessary to have more centers established, whereby the product that is demanded may be forthcoming. The northwest is bound by reason of its natural growth the result of natural causes and the logical sequence of events, to grow and become the scene of a large and widely growing activity in the iron trade.

Proximity to ores, fuel available and of the best quality, cheap transportation owing to direct lines and shorter hauls, will determine the situs of some of these yet-to-be-built furnaces, that are to supply the demand that, as has been so plainly and conclusively shown, will exist within a very few years.

Table III, taken from the census returns for the past four decades, shows the production of pig iron and distribution of population. (See page 8.)

In the above-mentioned table, from an address by John Birkinbine, President of the American Institute of Mining Engineers, in which the Southern States are considered as all those south of the Potomac and Ohio rivers, and east of the Mississippi, including Maryland and Louisiana; the New England States are the five States usually so called; and the Middle States comprise New York, Pennsylvania, New Jersey and Delaware, all the rest of the country being embraced under the term Western States. The figures for the United States are also given and as the table was prepared for a lecture to a local institute, those of Pennsylvania were separately stated in the table, besides being included in the Middle States.

This table shows, among other interesting features, that the *per capita* output of pig iron in the United States is now considerably less than that of Pennsylvania 30 years ago. In that period, the output of pig iron *per capita* in Pennsylvania has quadrupled and that of the rest of the United States, in the same time, has not quite kept pace with the Keystone State; although the Western States show a somewhat accelerated growth of output per inhabitant, and the Southern States a remarkable increase in this particular.

Taking the production of pig iron in the United States in the future at one ton for each six inhabitants, say 375 pounds *per capita* annually, the Western States must double their output of pig iron, and the Southern States increase their production 50 per cent. before they supply the requirements of their present population, if that population represents average consumers.

We have seen elsewhere that the probable number of inhabitants to be found in the Northwest territory which is tributary to Marquette will be about 10,000,000 in the year 1900. If we assume that they will be average iron consumers (as they are apt to be as the district is new, calling for buildings of modern construction, railroads, etc.) and will consume 375 pounds per capita, then there will be required within less than seven years from to-day, 1,670,000 tons of iron for this district alone. In addition to this, there will be the added increment of 6,000,000 tons of iron due to natural growth of the entire country for that year, above our present producing capacity. The Northwest should furnish in addition to its own wants (as evidenced by its growth of population) its share of the iron required by the rest of the United States, so that it may safely be assumed that there is an available market for at least 2,500,000 tons of iron, that will be dependent upon this district to produce and which may naturally be looked to as its source of supply.

In this territory there is to-day but one coke iron furnace, capable of producing about 130 tons of iron daily. The ore has been obtained from the Vermilion (and quite recently the Mesabi) and Gogebic ranges; the fuel is Connellsville coal carried up the lake during the summer months and coked on the ground as needed. The product of this furnace has been mainly a Bessemer pig, which has been rolled into ship and boiler plates. This is the only source of supply for the great market that now is held and controlled by the furnaces of Chicago.

The greatest output of iron ever made in any six months' period in this country was made in the first half of the year 1890 when there was produced 4,911,763 gross tons of iron, or at the rate of 9,823,526 tons per annum, an amount exceeding our largest yearly output by 620,823 tons. This excess would be equivalent to the output of about six of the largest furnaces in this country, operating continuously for one year.

SEVENTY MORE FURNACES WOULD BE NEEDED.

If, then, the increased demand over our present ability to

supply pig iron, for the year 1900 is to be about 6,000,000 tons, where will the furnaces be located that are to furnish this increase? It will call for at least 70 additional furnaces, each capable of producing 100,000 tons of pig iron annually; there are very few furnaces in this country that are credited with such a large annual output. The management of Furnace F, Edgar Thomson, have made public some of their records, and I herewith append a table, cited as being exceptional work, both in reference to output and fuel consumption:

TABLE IV—*Showing the working of Edgar Thomson Furnace F.*

Months.	Tons.	Pounds of Coke per Ton of Iron.
October, 1889	6,521	2,450
November, 1889	9,097	1,897
December, 1889	10,603	1,756
January, 1890	10,536	1,737
February, 1890	8,954	1,859
March, 1890	9,941	1,845
April, 1890	19,075	1,847
May, 1890	10,035	1,884

This shows an average output for the eight months cited (including the month the furnace was blown in) of 9,470 tons or equivalent to an output of 113,000 tons per annum. This, it must be borne in mind, is an exceptional record and has never been maintained for one year. The plant is modern and every aid has been given to increase the furnace yield. The principal dimensions of this furnace are: height of stack from hearth line to top platform, 79 feet 9 inches; crucible, 11 feet in diameter; bosh, which is straight for five feet, is 23 feet in diameter; its lower edge being 31 feet 6 inches above the floor of the crucible. It is further stated that counting the time the furnace was running in the first blast, and up to the end of May, 1890, in the second blast, including also the time spent in relining, the period covered is three years and five months; and in that time this furnace has made an output of 301,205 tons, a record which is unparalleled; this it will be noted is something less than an average of 100,000 tons per annum.

So that, in addition to the present producing capacity of this country, in order that its needs can be met, there will be called for at least seventy new stacks of the largest capacity or, one hundred of modern average capacity, most advantageous circumstances and placed where their product can reach the markets for which they have been planned to supply. In table No. V, is given a statement of the production of pig-iron and the percentage of Bessemer pig produced, showing that the average production amounted to nearly forty-two *per cent.* for 1891, while for the four years preceding there was produced over forty *per cent.* of the entire yield of the country. The growth of the demand for this grade of metal is one of the wonders of the end of this century, for it has grown from 8,500 tons in 1868, to over 4,000,000 tons in 1890, a period of twenty-two years.

TABLE V.—*Showing Production of Pig-Iron and of Bessemer Pig-Iron in the United States During the Five Years, 1887-1891, in Net Tons.**

	1887.	1888.	1889.	1890.	1891.
Bessemer Pig-Iron Produced	3,220,517	2,954,402	3,529,584	4,583,424	3,888,853
Total Pig-Iron Produced	7,187,206	7,268,507	8,516,079	10,307,028	9,273,455
Percentage of Bessemer Pig-Iron	44.81	40.65	41.45	44.47	41.94

*The net ton is used that the figures may agree with the statistics of the American Iron Steel Association.

If the same proportion of make of Bessemer pig holds for the year 1900, as it has held for the past five years, say forty-two *per cent.*, upon an estimated output of 15,000,000 gross tons of iron, there will be a probable demand of 6,300,000 tons of Bessemer pig-iron. To produce this amount of metal will require 10,500,000 tons of sixty *per cent.* iron ore. The Lake Superior region has for many years past furnished four-ninths of the total ore mined in the United States. This would mean a demand upon the Lake Superior region for 4,666,666 tons of Bessemer ore, if it furnished only the proportion of that grade of ore that it does of all ores produced in the United States. [As a matter of fact the Lake Superior region furnishes a considerably larger proportion of the Bessemer ores smelted in the United States than of non-Bessemer, so that Mr. Parker's figures—4,666,666 tons—will stand a considerable increase.—ED].

Incidentally this shows that the actual amount of Bessemer ore that is in sight in this Lake Superior region is apt to feel a very serious drain before many years elapse, and the opening and development of the Mesabi range of Minnesota, with its supply of Bessemer ore must be hailed by the steel men with undisguised pleasure, and, while it will for a few years ease the pressure for this grade of ore, the time is coming when an ore of a Bessemer grade, now regarded as too lean to be of value and neglected, will be sought for and utilized, and it will become a factor in the ore market.

I might go still further and inquire what becomes of pig-iron, and into what form is it destined to fulfill its mission, what amount of it goes into steel rails, nails, merchant bar, and the many other forms, but that line of inquiry would be of no particular value in a paper of this nature, which has been prepared to show that there must be an increased demand for iron, and that furnaces must be provided to furnish the amount so indicated as needed, and that the market is at our doors to be supplied when we can enter into competition with iron makers, who have established themselves where the only point in favor of their establishment is that of railroad facilities. They have a long haul on both their fuel and ore. A group of furnaces, located where their ore can be cheaply obtained, and where they can obtain coal and coke it, utilizing the waste heat of coking for steam-making (thus effecting a saving of fuel that is not attempted elsewhere, as the coke is purchased) and other useful purposes around the furnaces, will have much in their favor to insure their successful operation.

At Marquette the rail-haul need not exceed twenty miles to reach a supply of all kinds and grades of ores, world-famed for their richness and purity; fuel is cheap, likewise labor, because of the low cost of living; taxation and real estate values are low. These advantages and the fact that it commands the markets of the Northwest by its geographical position, lying in the pathway of the stream of traffic flowing east and west, all have their weight in deciding that at least one of the most available points for the economical manufacture of pig-iron is Marquette, Mich.

MARQUETTE, MICH., March 20, 1893.

"Princess" Pig Iron.

This iron is made from a high grade of brown hematite ore mined at Glen Wilton, Botetort Co., Va., on property close to the furnaces. The ore is selected with great care and smelted with first quality of coke from the new river district in West Virginia. The iron is soft, strong and very fluid; it is well suited for all kinds of castings, the lightest or heaviest, and will make excellent stove plates. It is adapted for work in which great strength is needed, as cylinders and other engine castings, spur wheels, pulleys and all kinds of machinery and hydraulic castings, architectural iron work, rolling mill work and any other uses requiring a high grade of iron. As a coke iron superiority is claimed for it and few grades of charcoal iron are its equal. The following analysis made by J. Blodget Britton, of Philadelphia, Pa., Oct. 31, 1892, will show the elements found in this iron and indicate the varied uses that can be made of it:

	No. 1.	No. 2.	No. 3.
Graphite carbon	3.990	3.393	3.450
Combined carbon	.380	.240	.340
Silicon	.....	2.200	.....
Sulphur	.....	.012	.....
Phosphorus	.....	.607	.....
Manganese	.....	.533	.....

Hyatt, Mathews & Co., of Cincinnati, sales agents for the Princess pig iron, have strong testimonials from the Bureau of Steam Engineering Navy Department, Washington, D. C.; South Side Foundry & Machine Works, Charleston, W. Va.; Richmond & Danville R. R. Co., Washington, D. C.; Joseph Bell Stove Co., Wheeling, W. Va.; the McNamar Machine Works, Newark, O.; the Richmond Locomotive Machine Works, Richmond, Va.; Hanging Rock Stove Co., Hanging Rock, O.; Madison Machine Co., Madison, Ind.; Richmond Stove Co., Richmond, Va.; the Wallace Mfg. Co., Frankfort, Ind.; Hooven, Owens & Rentschler Co., Hamilton O., and from other manufacturers in various portions of the country engaged in manufacture of tubes, machinery of various kinds, stoves, architectural iron work, etc. All speak in high terms of the "Princess" iron, for all its special uses.

AS AN IRON CENTER.

CHICAGO'S IMPORTANCE SHOWN BY FIGURES.

More Iron Melted in Foundries than in any Other City in the Country.

It is not so widely known as the fact merits, to what a large extent the iron business of Chicago has grown in recent years, but it is worthy of note that very few districts in the country will compare with the Chicago district, in the number, variety, or value of its iron products.

Beginning with the primary product, iron ore, there are three Chicago firms that have sold ore in the past year: Crerar, Clinch & Co., Pickands, Brown & Co., and Chas. Himrod & Co. These firms marketed in the year 1892 an aggregate of 460,000 tons of iron ore, of which 160,000 tons was non-Bessemer and 300,000 tons Bessemer ore. Large sales have also been made in the Chicago market by outside concerns, principally those in Cleveland.

The amount of pig iron consumed in Chicago in a year in the various iron manufacturing industries is larger than that used in any other city in the United States except Pittsburg. In the foundry business, exclusive of mills, Chicago leads even Pittsburg, and uses more iron than any other city in the United States. A large portion of the pig iron used in Chicago is made in the furnaces located in that district, or in the Northwest, controlled by Chicago capital.

PIG IRON PRODUCTION.

The list of furnaces is headed by those owned by the Illinois Steel Co. Of these there are 19 stacks; 14 in Chicago, three in Joliet and two in Milwaukee. They comprise the North works, located at Chicago having two stacks, each 66x15½, built in 1869; and six fire-brick stoves of various types. The product is spiegeleisen and foundry pig iron. The annual capacity is 110,000 net tons.

The South works, located at South Chicago, have four stacks, each 75x20, built in 1880-81; 12 Whitwell stoves; the product Bessemer pig iron, annual capacity 325,000 net tons; and four stacks, each 80x21, built in 1890-91; 16 Massicks & Crooke stoves; product, Bessemer pig iron, annual capacity 355,000 net tons.

The Union works have two stacks, each 72x14, and two stacks each 73x15½, having two Siemens-Cowper, two Siemens-Cowper-Kennedy, and eight Siemens-Cowper-Foote stoves. Product is spiegeleisen, ferro-manganese and Bessemer pig iron; annual capacity 207,000 net tons.

The Joliet Works, at Joliet, Ill., have three stacks, each 80x20. The product of which is Bessemer pig iron, with an annual capacity of 243,000 net tons.

The Milwaukee Works have two stacks, six Massicks & Crooke stoves. The product is foundry and mill pig iron, annual capacity 110,000 net tons. The total annual capacity of the 19 furnaces is 1,350,000 net tons. The fuel used in all the furnaces is Connellsville coke. The ore used is Lake Superior, Gogebic and Minnesota for Bessemer pig, and foreign, Southern and Western for spiegeleisen and ferro-manganese.

The Calumet furnace, owned by the Calumet Iron & Steel Co., has one stack, 75x18, one Massicks & Crooke stove and three Siemens-Cowper-Cochran stoves. The product is Bessemer foundry and mill pig iron, and the annual capacity 50,000 net tons. The fuel used is Connellsville coke; ores, Lake Superior and Menominee. This furnace is out of blast, but it is expected to blow in some time this spring.

The Iroquois, owned by the Iroquois Furnace Co., located at South Chicago, has one stack 80x20; three Cowper-Kennedy stoves. The product is pig iron, with an annual capacity of 60,000 net tons. The fuel used is Connellsville coke, and the ore, Lake Superior. The selling agents for this furnace are Forster, Backman & Hawes, of Chicago.

The total capacity of Chicago furnaces, including the Milwaukee and Joliet of the Illinois Steel Co., is 1,459,000 net tons. Much the larger part of the product of furnaces owned by the Illinois Steel Co. is used in the mills of the company, though a portion is sold in the Chicago market by the furnace sales agents Pickands, Brown & Co.

The amount of pig iron sold by the Chicago dealers in the past year, as specially reported to *The Iron Trade Review*, closely approximates 700,000 tons, of which about 285,000 tons was local coke iron; 160,000 tons Southern coke; 150,000 tons Lake Superior charcoal; 75,000 tons Ohio; 15,000 tons Southern charcoal, and 15,000 tons of various other irons.

FOUNDRY PIG IRON CONSUMPTION.

Of these amounts about 285,000 tons were sold to the various foundries located in Chicago and its suburbs, in amounts approximately as follows:

	Tons.
Local coke	140,000
Southern coke	65,000
Lake Superior charcoal	45,000
Southern charcoal	13,000
Ohio irons	12,000
Other irons	10,000

A GREAT FOUNDRY INTEREST.

In number and capacity of foundries, Chicago leads the country over all other cities, having 91. Of these there are several of exceptionally large capacity operated by manufacturers of agricultural implements, car wheels, mining machinery and general foundry products. Among its other manufactories, Chicago has that of the Grant Locomotive Works, who, while they are hardly fairly started, have an annual capacity of 200 locomotives of all kinds.

There are also four builders of cars of various kinds in the city as follows:

The Corey Car Mfg. Co., builders of dump and mine cars; Harvey Steel Car Co., Works at Harvey, builders of steel and wooden freight cars; The Pullman Palace Car Co., builders of passenger, freight and street cars, and the Wells & French Co., builders, of freight, refrigerator, and caboose cars. Of car wheel manufacturers there are six: The Allen Paper Car Wheel Co. with their works at Pullman, have an annual capacity of 18,000; Barnum & Richardson Mfg. Co.; J. H. Bass with an annual capacity of 45,000, and the Griffin Wheel & Foundry Co., daily capacity 800; The Union Foundry & Pullman Car Wheel Works, annual capacity 100,000; The Wells & French Co., annual capacity 75,000. Of car axle works Chicago has three: The Chicago Forge & Bolt Co., annual capacity, 50,000; Pullman Palace Car Co., and the Willard Sons & Bell Co., annual capacity 40,000.

CHICAGO'S ROLLING MILLS.

The capacity of the various rolling mills and steel works of Chicago is very large, the leading mills, of course, being those of the Illinois Steel Co. This company has three plants in Chicago, one at Joliet and one at Milwaukee. The North Works in Chicago have eight heating furnaces and three trains of rolls. Bessemer Steel Works have two 6-gross-ton converters, and all appliances for the manufacture of rails. The product is Bessemer ingots and rails; annual capacity, 156,000 net tons of ingots, 125,000 tons of rails and 50,000 tons of beams.

The South Works at Chicago have three 10-gross-ton Bessemer converters; ten Siemens heating furnaces; one 3-high 40-inch blooming train, and two 3-high finishing trains of rolls. The product is Bessemer ingots and rails; annual capacity, 480,000 net tons of ingots, and 40,000 tons of rails.

The Union Works have two 10-gross-ton converters; five cupolas; four spiegel cupolas; one 3-high 3-inch blooming mill; four gas ingot heating furnaces; one gas blooming heating furnace, and one 3 high 25-inch rail train. The product is Bessemer steel rails; annual capacity, 350,000 net tons of ingots.

The Joliet Works, at Joliet, have two 8-gross-tons Bessemer converters, and the annual capacity is 235,000 net tons of ingots. The steel rail mill has 10 heating furnaces, one 36-inch blooming train and one Seller's 3-ton hammer. The annual capacity is 210,000 tons of rails. The wire rod mill contains one Garret mill with three gas furnaces and has an annual capacity of 60,000 net tons.

The Milwaukee Works have eight quadruple puddling furnaces; 19 coal and 16 gas heating furnaces; eight trains of rolls and one hammer. The products are light rails, merchant bar iron and steel, and fish plates; annual capacity, 80,000 net tons bar iron and steel, and 40,000 tons of fish plates, etc.

The Calumet Works, owned by the Calumet Iron & Steel Co., at South Chicago, have been lying idle during the past year and have recently started up. They have 38 single puddling furnaces; six scrap and six heating furnaces; three trains of rolls; 132 nail machines. The products are merchant bar.

iron, iron and steel nails. The annual capacity, 50,000 net tons of bar iron; the Calumet Works have also four 4-gross-ton open-hearth steel furnaces, the product of which is steel for nails, merchant bar, and steel castings, and the annual capacity is 20,000 tons.

The Chicago Splice Bar Mill owned by Morris Sellers & Co., has three heating furnaces and two trains of rolls. The product is splice bars, and the annual capacity 12,000 net tons.

The Chicago Forge & Bolt Co. have six heating furnaces and one 10-inch and one 18-inch train of rolls. The product is architectural material to an annual capacity of 25,000 net tons.

The Chicago Tire & Spring Co. have two heating furnaces and one universal tire mill. The product is locomotive and car wheel tires, and all kinds of rings. The steel department contains one 8-gross-ton open-hearth furnace, the product of which is ingots, castings, and manganese steel, and the annual capacity 6,144 net tons.

The Fowler Rolling Mill Co. has one forge fire, two heating furnaces, and one 9-inch train of rolls. The product is railroad spikes to the amount of 80,000 kegs.

The Corning Steel Co. have a plate mill at Hammond, Ind., containing four trains of rolls and one 2-ton hammer. The product, steel sheets and light plates. The mill also contains a 20-ton basic open-hearth steel furnace.

AS A MACHINERY CENTER.

Chicago has among its manufacturers of machinery some of the largest makers of agricultural implements in the country. Among them may be mentioned Wm. Deering & Co., the McCormick Harvesting Machine Co., and the Plano Mfg. Co. The last named company, who have their works at Plano, Ill., a suburb of Chicago, have decided to remove their plant to West Pullman, where they will have a capacity at least three times as large.

The Whitman & Barnes Co., of Akron, Ohio, have also recently made arrangements to come to Chicago, and will erect a very large plant for the manufacture of agricultural implements at West Pullman.

The manufacture of mining machinery is carried on in Chicago to a very large extent. Some of the largest firms in the country are located there, and their sales extend all over the world. Among the more prominent firms are the M. C. Bullock Mfg. Co., Fraser & Chalmers, the Gates Iron Works, Chicago Iron Works, and the Sperry Electric Mining Machinery Co. The machine shops of Chicago are many, and in them is built machinery of nearly every kind and for all purposes. There are over 100 of them inside the city limits, and a great many in the suburbs.

Besides these nearly all the larger builders of machinery in the East have agencies and many of them stores, in Chicago. Several large builders of engines and boilers have shops here, and the business is of large dimensions and rapidly increasing. New works of various kinds are continually started, and the industrial suburbs of Chicago are offering to manufacturers of machinery and iron products in other parts of the country, advantages that have induced many of them to remove their plants to Chicago, or at least to start branches there. Among the most recent and noteworthy of the removals are those of the Plano Mfg. Co. and Whitman, Barnes & Co. to West Pullman; the Walburn Swenson Mfg. Co., manufacturers of sugar refining machinery, machinery for chemical works, mining machinery, etc., to Chicago Heights, where they have nearly completed a large and modern plant; and the General Engineering Co., successors to A. J. Sweeney & Sons of Wheeling, to Harvey, where they have erected a foundry and machine works for the manufacture of machinery for plate glass works, nail factories, rolling mills, iron works, etc. The Michigan Peninsular Car Works have closed a deal for 150 acres at West Pullman, to which they propose to remove their Detroit plant.

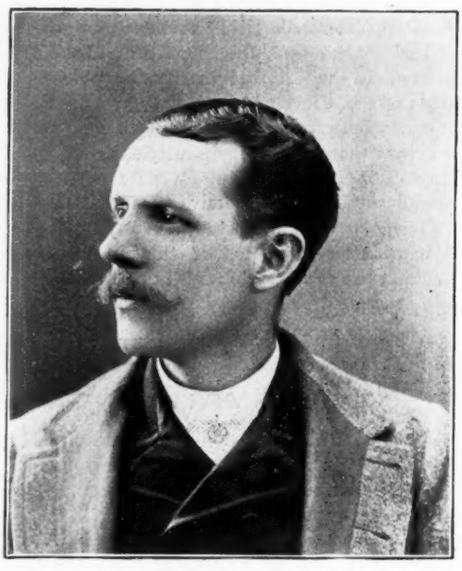
The Detroit Foundry Equipment Co. are about to erect a large building at Chicago Ridge for the accommodation of their Detroit plant.

Altogether Chicago may claim the credit of being one of the largest iron centers in the United States, and there is no doubt that it leads in a great many of its manufactures, and will probably be at the head of manufacturing centers in a very few years, if it maintains its present rate of progress.

FOUNDRYMEN-AUTHORS.

THOMAS D. WEST.

A young man, reckoning by the calendar, and yet one who has already crowded more than a life-time's experience and achievement into his active years, is Thos. D. West, whose portrait is presented on this page. He was born in Manchester, Eng., Aug. 31, 1851, and six months later his parents settled in New York City. After a move to Canada, and a residence there for some time, the family went to Portland, Me., and in early war days the boy of nine sold newspapers. His regular routine meant rising at 3:30 A. M., sweeping out the office



THOMAS D. WEST.

of the Portland *Argus*, then folding papers, and at 5:30 starting out to deliver a route of 50 papers. The morning was spent at school, and at noon he took out extra papers, when there were any. After school in the evening he was again busied with folding papers, later taking out a route that lay through Fort Preble and Cape Elizabeth, returning by ferry boat at 9 P. M. In case of an extra edition he continued his sales in Portland until 11 P. M. This taxing regimen was kept up for a year and half. The revenue often went as high as $2 a day, saying nothing of the added return in tact and knowledge of the world that stood him well in stead later on.

Before he was 11 young West entered the foundry of the Portland Locomotive Co. to learn the moulder's trade. After serving three years with his stepfather, Andrew Baird, he went to Hinkley & Agery's works, at Bangor, Me., putting in three years more.

A journeyman at 16, he started for New York and found employment with John Roach, the great ship builder. Night school came between days of hard work in the foundry. Two years in New York were followed by a migratory two years, in which the subject worked in leading foundries in the Eastern and Middle States. Coming to Cleveland in 1871 he entered McNairy & Claflen's foundry, and later the Globe and Eclipse works. At the age of 21 he occupied the foremanship of Thos. Manning & Son's foundry, and subsequently had the position of foundry manager at Wm. Tod & Co.'s, Youngstown, and Wm. Fitzsimons & Son, Variety Iron Works, and Cuyahoga Works, now Cleveland Ship Building Co., of Cleveland. He was connected with the Cuyahoga Works under the presidency of J. F. Holloway, for six years, leaving its employ to go into partnership with Samuel Lansdowne and Chas. Neracher, the firm title being the Thos. D. West Foundry Co. They started in Cleveland with a shop 50x60 feet, and in two years extended it to a length of 350 feet. On the evening of Jan. 13, 1892, the plant was burned to the ground. The foundation for a new works was started, on the same ground, but it was decided to abandon this enterprise and engage at Sharpsville, Pa., in the manufacture of ingot moulds. The Thos. D. West Foundry

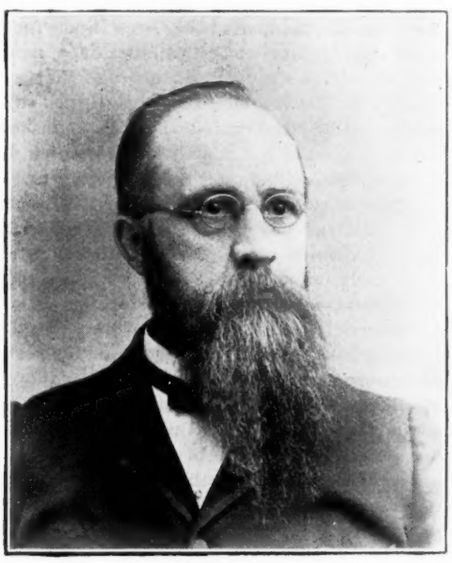
Co. is the incorporated name of the new company, with Geo. H. Boyd as president and treasurer, and Mr. West is manager of as finely equipped a foundry as is to be found in the country. The melt of iron is 50 tons a day.

Up to the time of his marriage, in 1874, Mr. West retained the name of his step-father, and to many he is to-day known only as Thos. D. Baird. Mr. West's contributions to foundry literature began in 1880, when he first wrote for the *American Machinist*. In 1882 he brought out his first work on moulding, *American Foundry Practice*. Three years later a second work appeared, his *Moulder's Text Book*. These works were written evenings after the author had done his day's work in the foundry, and those who know him know that Mr. West's day in the foundry is not an eight-hour day by any means. Both these works are highly prized by practical foundrymen and mechanical engineers the world over, and probably have paid their author as large royalties as any mechanical works that have been written. Though busily employed with the responsible duties laid on him in the management of the Sharpsville foundry, Mr. West is again burning midnight oil to bring out two more books, which he is sanguine will meet with the success attending the publication of the others.

Mr. West is a member of several organizations, among them the American Society of Mechanical Engineers, and the Civil Engineers' Club, of Cleveland. Also claims credit as an inventor having taken out several patents in his time. He is in the prime of life, wrapped up in his chosen work, but full of ambition for his three bright children. For himself, his busy life is a continual enunciation of his wish to die of hard work rather than rust away.

SIMPSON BOLLAND.

The name of Simpson Bolland has long since become familiar both among proprietary and operative representatives of the foundry interest. It is a name that has always been synonymous with a forward movement in all matters of foundry practice. Mr. Bolland's pen has stimulated progress in foundry work and his progressive ideas have found favor because they were the fruit of long and varied experience in the molding room. Not only have his articles had a wide reading at



SIMPSON BOLLAND.

home, as they have appeared from time to time in mechanical and trade journals, but their reproduction across the water has added other thousands of readers to the author's large constituency. What Mr. Bolland has wrought in foundry literature has been produced under adverse circumstances, in the face of obstacles that would have been insurmountable to a less studious and less determined man.

Born in Manchester, Eng., July 22, 1838, he entered the railway foundry of E. B. Wilson, at Leeds, when 12 years old. He began work two years later at Wren, Wren & Hopkinson's, Manchester, and went thence to Hyde, Cheshire, where, at the age of 16, he was again apprenticed to B. Goodfellow, engineer, until 21 years old.

During the years of his apprenticeship he was studious and eager in the pursuit of information relative to his business, and before he was 22 he became foreman at Martin & Smethurst's, Guide Bridge, leaving that shop to travel in the pursuit of experience. Three years later he became foreman of the Caledonia Foundry, St. Helen's. Bent on acquiring more information, however, he left and went to work in the Vauxhall Foundry, Liverpool, subsequently, after a space of two years, assuming charge of Green's Foundry, Macclesfield.

At the age of 32 he removed to the United States and worked a year and a half at North Brooklyn Foundry and Henry R. Worthington's in Brooklyn, N. Y., leaving them to become assistant foreman at Delamater's, New York. Thence he went to the Newark Iron Works as foreman, twelve months later taking charge of the Atlas Iron Works of the E. W. Bliss Co., Brooklyn. Three years later he took charge of the Union Foundry at Catasaqua, Pa., returning after two years to Brooklyn. Upon the death of Mr. Fred Sibley, who for 25 or 30 years had been in charge of Delamater's Foundry, New York, the position was offered to and accepted by Mr. Bolland, who remained there until the death of the head of the firm caused the closing up of the works. Shortly afterwards he took charge of the very extensive foundry plant of J. B. & J. M. Cornell, in New York.

Mr. Bolland not alone enjoys the esteem of his employers, but also that of a wide range of acquaintances in all parts of America, employers and foremen frequently consulting him on all trade matters, and many foremen in good positions being indebted to him for them.

Mr. Bolland has had the confidence of his employers in all his varied and responsible service, and in the last score of years has built up an extensive acquaintance among proprietors and foremen who frequently consult him on matters of practice. He is thoroughly practical and can point with proper pride to some of the best work ever produced in New York and Brooklyn either in loam, dry sand or green sand.

Articles by Mr. Bolland have appeared in various journals devoted to foundry and machine shop interests, and within the year he has brought out "The Iron Founder," a volume of great value to the entire foundry interest. A supplement is now in press. We take pleasure in presenting the author's portrait. Mr. Bolland's address is 44 Prospect Ave., Windsor Terrace, Brooklyn, N. Y.

LAKE SUPERIOR MINING INSTITUTE.

There were upwards of 175 representatives of the mining interests of the Lake Superior region in attendance at the sessions of what is to be known as the Lake Superior Mining Institute, held last week, in Wood's Hall, at Iron Mountain, beginning on Wednesday evening, March 22. Maj. Mason W. Burt, of the Newport mine, presided and at the first session stated the object of the proposed association, correcting the impression given by certain published statements, that it was to have part in fixing prices of labor or product. The scheme of organization adopted at a later meeting made this subject very plain in these terms:

"The objects of the Lake Superior Mining Institute are to promote the arts and sciences connected with the economical production of the useful minerals and metals in the Lake Superior region and the welfare of those employed in these industries by means of meetings for social intercourse, by excursions and reading and discussion of practical and professional papers and to circulate by means of publications among its members the information thus obtained."

The appointment of committees on permanent officers and organization was the only business of the first session. This done, the excellent paper of Per Larsson on "Soft Ore Mining on Lake Superior" was given, as appended in full to this report. The discussion was participated in by J. B. Knight, of Norway, State Commissioner of Mineral Statistics, and J. Parke Channing and Jno. T. Jones, of Iron Mountain, Mich.

Thursday was given over to visiting. The great Chapin pump was a special attraction. The entire weight of the plant, as already given in these columns, is 675 tons. The bailing operations at the Hamilton mine were looked into, each hoist bringing up 2,600 gallons of water. A train to Norway in the

afternoon permitted the inspection of the Aragon and East and West Vulcan mines.

At the evening session Mr. Brady, representing Commissioner Peter White, urged a thorough representation of Lake Superior mineral wealth at the World's Fair. Dr. Nelson P. Hulst, of Milwaukee, made an exhaustive address, aided by charts, on the "Geology of that Portion of the Menominee Range East of the Menominee River."

By-laws were adopted, providing for meetings on the first Wednesday of March and September of each year; limiting membership to those identified with mining pursuits and science. The fall meeting will be held at Ishpeming. The following officers were elected: President, Nelson P. Hulst, Milwaukee; vice-presidents for two years, Jno. T. Jones, Biwabik and Iron Mountain; F. P. Mills, Ishpeming; Graham Polk, Hurley; vice-presidents for one year, M. W. Burt, Ironwood; J. Parke Channing, Crystal Falls; managers for two years, W. Fitch, Champion; Jno. Duncan; vice-presidents for one year, Jas. MacNaughton, Iron Mountain; Chas. Monger; Wm. Kelly, Vulcan; treasurer, C. M. Ross, Bessemer; secretary, F. W. Denton, Houghton Mining School.

Soft Ore Mining on Lake Superior.

BY PER LARSSON.

"Soft ore" being a relative term, it is necessary to explain that in this paper reference will be had to the brown hematites and limonites of the Marquette range, locally called "hematites," to the ores occurring east of the Menominee river on the Menominee range, to all the Gogebic and Mesabi ores and the Ely group on the Vermilion range. The ores occurring west of the Menominee river on the Menominee range may be as soft to drill as some of the ores just mentioned, but they are tough and strong and can be mined by methods prevailing in the hard ore regions. The methods of mining made use of in the Lake Superior soft ore mines are the following:

1. Stripping and open pit work.
2. Rooming and timbering.
3. Filing.
4. Caving.

Stripping and open pit work.—Open pit mining has been used more or less on all the Lake Superior ranges. The stripping has been done by pick and shovel or by scrapers, and the ore has been hoisted by derricks or over skiproads built on the slope of the banks. As, however, the ore deposits on all the older ranges, dip at angles over 45°, almost without exception, the limit of the open pit mining has soon been reached in each case. The discovery of the flat deposits of iron ore near the surface on the Mesabi range has lately revived the interest in this method of mining, and it will undoubtedly be used there on a much larger scale than on the older ranges. Steam shovels and locomotives are already pressed into service for removing the earth from above the ore beds, and though the strippers have suffered a temporary set back, owing to the difficulties of operating the steam shovels in the frozen banks during the last severe winter, they will eventually prove that the "stripping proposition" is both feasible and economical in the end. The question has been raised as to the amount of surface that can be economically removed, and in this respect I would state, as a basis for discussion, that where the volume of ore to be uncovered is equal to the volume of surface to be removed, it will pay to strip.

Rooming with Timbering.—The system of rooming with timbering has been more extensively used than any other in our soft ore mines. The general plan under this system is to mine out certain blocks of an ore body on a given level in advance of others, that are left temporarily for the purpose of supporting the rock walls. The relative size of these rooms and pillars varies greatly, but it is quite common to make the rooms from twenty to twenty-four feet wide and the pillars somewhat less. The length of rooms and pillars is equal to the width of the ore body. The rooms are worked from bottom to top of each lift and heavy structures of timber are built up in the rooms as the mining proceeds upwards. In some of the larger mines, where this system has been employed, these huge underground structures have collapsed under the pressure from the surrounding walls, and in such cases the rooming system has either been abandoned or materially modified. Such extensive caves have, of course, temporarily checked the output of ore and the system itself has sometimes fallen into disrepute. But in cases where the size of the ore deposit is limited, it affords a possibility of a forced output, a fact that commends it to mine owners. The great cost of the heavy timbering that it requires is, of course, one of the greatest objections to it. This cost rarely falls below twenty-five cents per ton of ore.

The Filling System.—Rock-filling is often used in connection with rooming in which case lighter timber can be used or entirely dispensed with. Where it is absolutely necessary to keep the surface above a body of soft ore from settling, as for instance in a swamp or under a townsite or under a main line of railroad, no other system than this combination of rooming and filling will answer the stated purpose as well. But such cases are not very frequent. The instances in ordinary mining practice, where rock-filling is most economical and advantageous are those, where the filling material can be put into the desired place without the use of a shovel, or in other words, where it is not required to put in the filling close up to the back of a stope. Such a case occurs in the Chapin mine, where on the lower levels the ore is of sufficient firmness to hold up without the use of timber in twenty-foot rooms carried across the whole width of the ore formation. Here the stopes are taken nine feet high, and the rock-filling is dumped by small cars within four feet of the back after the completion of each stope.

Other cases where rock-filling is used are those where narrow deposits of ore can be mined longitudinally with stopes reaching from foot to hanging wall. In such cases the rock-filling is kept pretty close after the miners, unless the hanging wall is firmer than we usually find it in soft ore mines.

The system of filling introduced eight years ago into the Chapin mine, whereby the whole ore body in each lift was mined by slicing the ore out floor after floor from bottom up, and by filling each slice close to the back with rock, has been abandoned on account of the great expense of shoveling, filling into the stopes and the high cost of the necessary openings.

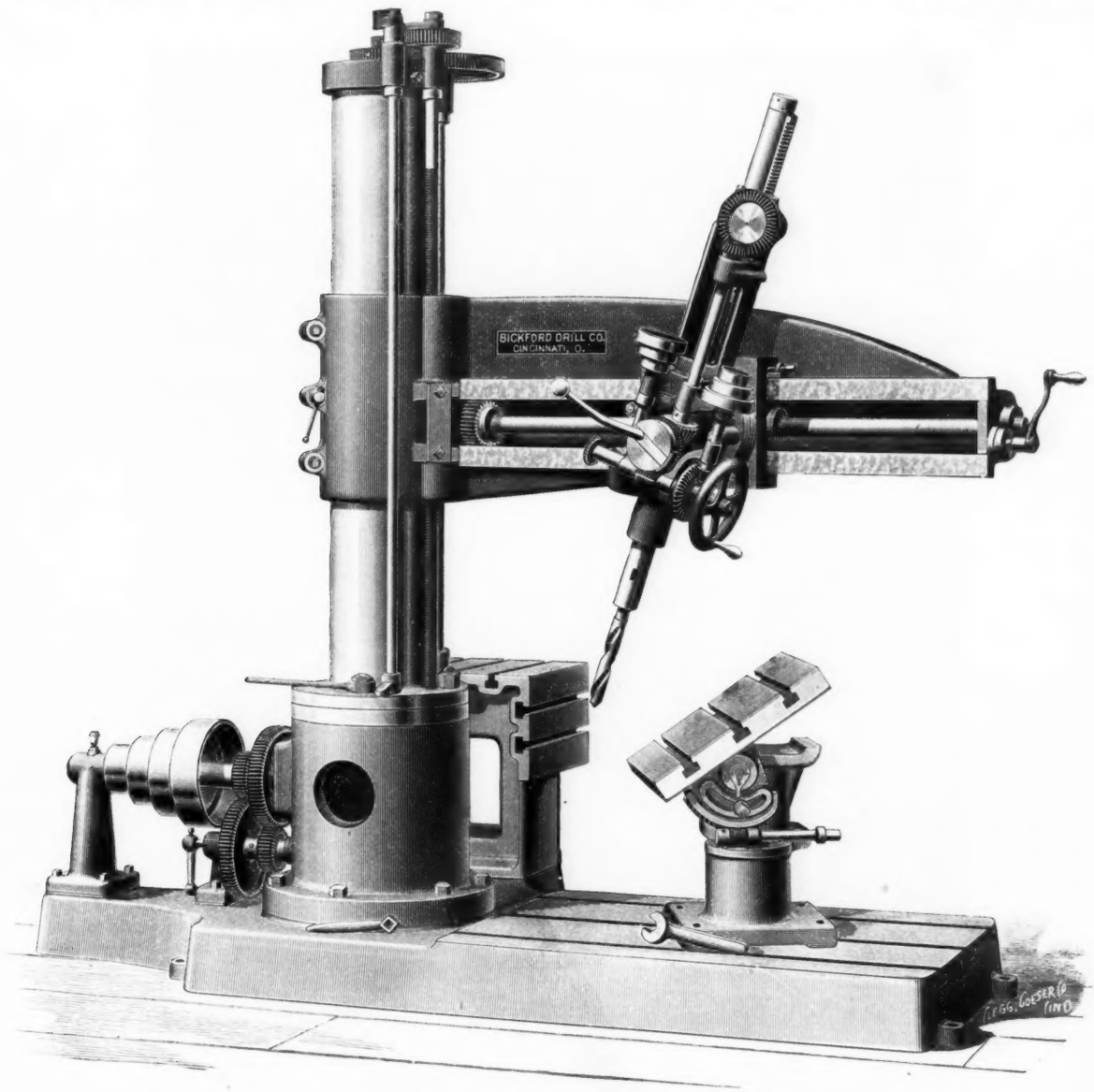
Caving.—Two distinctly different applications of the caving method are now used on Lake Superior. In the one the miners commence stoping at the top of a lift and are always working under a "gob" roof, while in the other they attack the ore at the bottom of a lift and work under a crumbling block of ore, which keeps sinking down to them. The former method has long been employed in European soft ore mines, especially in the north of England, and it has been in use for a number of years in this region, while the latter is a new method, adopted on a large scale one and one-half year ago in the Chapin mine. The former is well adapted to such soft ground, where the ore can be mined chiefly by pick and shovel, while the latter can be used in quite firm ground, which breaks up more or less in settling, before it reaches the miners, the bottom floor alone being in its natural solid state when mined. The north of England system has the advantage that it can be used in irregular bodies without danger of leaving off-shoots from the main ore body. Where it is desired to use the Chapin system in relatively flat or irregular ore bodies, it becomes necessary to make the lifts short. In such cases it may be found advantageous to use a modification of the north of England system, such as is now successfully employed in the Chandler mine, where each lift is mined from top down, but each floor is taken fifteen feet thick. Other applications of the caving system may be seen in the Norrie and Lake Angeline mines, where on the chamber-and-pillar plan the ore is mined in vertical sections from the hanging to the footwall, and the hangingwall rock or the overlaying "gob" is caused to run into these section as they proceed towards the foot.

In conclusion it may be said that the conditions that meet the miner in the different mines are so varied that no two mines can be worked by exactly the same plan. Such of us that have had pet methods are fast giving them up. Those that have advocated filling may occasionally find it to their interest to cave, and those that are professional cavers are sometimes found to be engaged in rooming, and we would perhaps all be only too glad to join our Mesabi friends in adopting their "stripping proposition," if nature had not turned our ore deposits edgewise in the ground. We must, however, adapt ourselves to the conditions that meet us, and, by learning from each others' experience, endeavor to keep ourselves to the front among American miners.

BICKFORD HALF UNIVERSAL RADIAL DRILL.

The machine illustrated on this page represents the new style A and D half universal radial drill which has just been placed on the market by the Bickford Drill & Tool Co., Cincinnati, the well known builders of upright, radial and universal radial drills, also of boring and turning mills. This machine was designed specially for the use of parties who do not require a full universal radial drill. Its head can be swiveled upon the arm at any angle, while in the full universal radial drill the head can be swiveled at any angle and the whole arm is made to revolve around its own axis.

We note the following features of this drill: The base is very heavy and deep, ribbed and braced on the under side so as to avoid all spring. The column is bolted to the base and extends all the way to the top of the drill. Over this column, with long bearing on top and bottom, is fitted the sleeve which carries the arm. This arrangement practically gives the machine a double flange and it is fitted with three clamping bolts. The arm fits over the sleeve, is of a box form, strongly braced, and raises and lowers by power. The machine is provided with roller bearings, so as to allow the arm to swing with perfect freedom. The spindles are counterweighted, have powerful automatic feed and are all fitted with the Bickford patent quick return motion. By addressing the manufacturers, Bickford Drill & Tool Co., Front and Pine streets, Cincinnati, O., interested parties can secure full details, prices, etc., on these machines.



BICKFORD HALF UNIVERSAL RADIAL DRILL.

THE great structural steel plant now nearing completion at Ironton, near Duluth, will probably be in operation by July 1. The main building, 100x400 feet, is now receiving the machinery. The engine bed is completed and the bed plates of the mammoth machine are now being placed. One piece alone weighs 20 tons. The engine bed contains not less than 225,000 brick, is 16 feet deep and 25x40 feet in area. In the bottom are two feet of concrete. The engine's said to be the largest at the head of the lakes and has cylinders 36x48 inches. Adjoining the engine, the foundation of the furnace is taking form. It is lined with fire brick and the fuel will be gas. The furnace is 30 by 12 feet and including the pit measures 25 by 30 feet. In a short time it is expected this building will be ready for the rolls and other machinery. The producer, 40 by 100 feet, at one corner is completed, as also is the boiler house on the same side. The latter is 40 by 120 feet and has twelve 100-horse power boilers, in batteries of four, already placed. The "annex," which will be used for the finishing and shipping departments, is 60x220 feet. One great feature of all the buildings is their substantial construction—heavy walls, heavy girders and braces and superior roofs. Next year it is expected that a blast furnace will be built and that the main building will be extended 200 feet.

THE Duquesne Steel Works of the Carnegie Steel Co. will be closed April 3 and remain so for six weeks and the capacity will be increased to over double what it is at present. Additions will be made to the rolling departments, so that the product can be changed at short notice to steel rails of any pattern. Ten new drill presses and rail straighteners will be added. In the blooming mill new furnaces of the improved plan will be built so as to handle more steel. At present there are two vessels of eight tons' capacity each in the converting depart-

ment. Three new converters of 15-ton capacity will be erected in their places, as also some new cranes. The changes will give employment to additional men. In the summer the work of erectiug two blast furnaces will be started to the east of the steel works. They will be known as furnaces 1 and 2, and will be built on the plans of the Edgar Thomson furnaces.

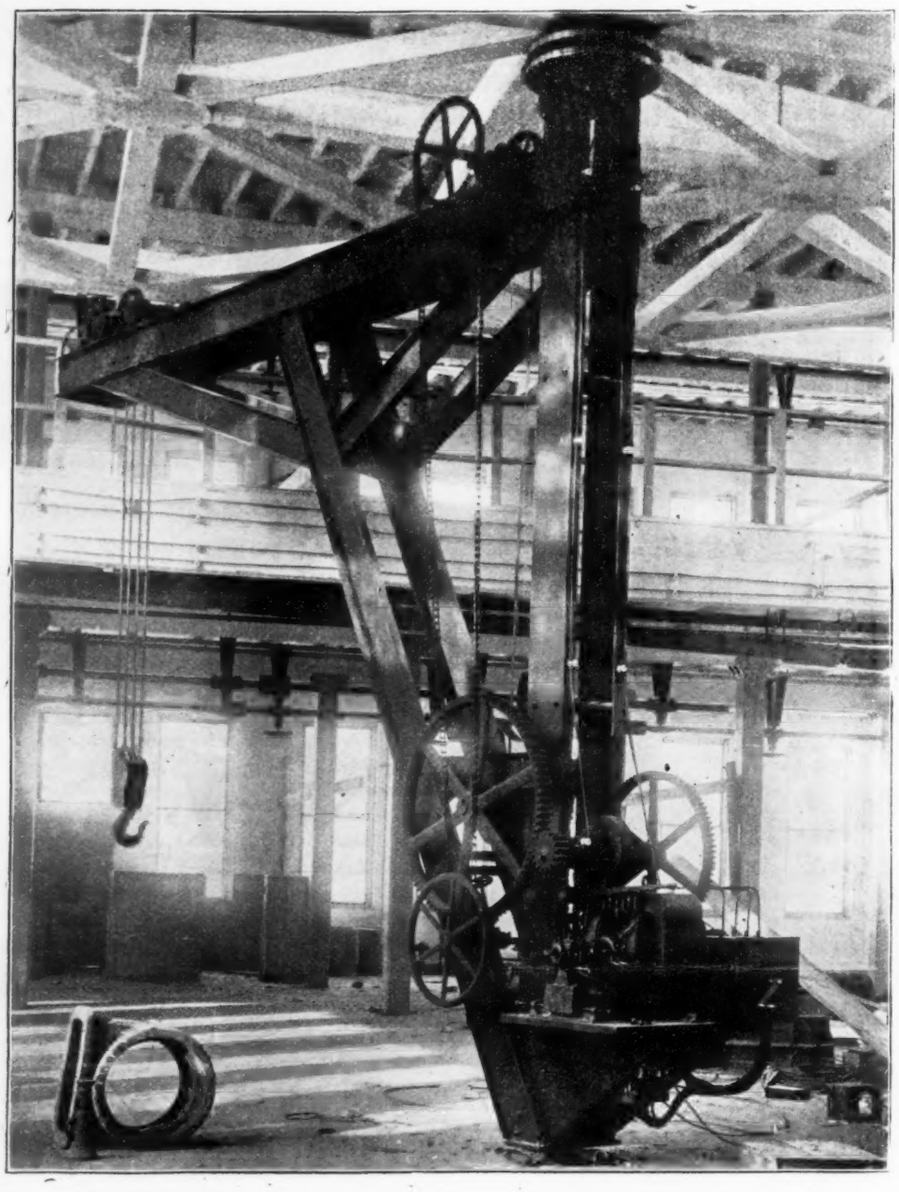
THE General Electric Co. have decided to build a mammoth plant northeast of Akron, O. They have secured a large tract of land and have options on considerably more. The Schenectady works will be abandoned. The company is at present buying a large portion of its heavier supplies from the Akron Iron Co., of Akron, and the Falls Rivet Co., of Cuyahoga Falls. The freight on these to the large plants in the East has been enormous, and it is desired to locate near to the producers of these supplies. Another reason is that the company desires to locate another factory in the Ohio Valley, where the demand for electrical supplies is increasing at a rapid rate. The plant, it is said, will be the largest in the United States.

THE Ordnance Board of the U. S. Navy accepted 500 tons of 12-inch nickel steel armor manufactured by the Bethlehem Iron Co. for the battleship Texas, after successful ballistic tests at the Redington proving grounds. The test plate was 12 inches thick, 16 feet long, 8 feet 4 inches high and weighed 30 tons. It was neither broken nor cracked. The projectiles, fired at a velocity of 1,678 feet to 2,004 feet a second were somewhat upset, but not broken. The material accepted is valued at $300,000.

ELECTRIC JIB CRANE.

One of the convenient uses to which electrical power is being applied is in the operation of cranes, hoists, etc. Before its introduction, the belting, or driving in any convenient and practical manner of machinery of this kind was always a puzzling problem. Rope drivers and square shafts were extensively introduced and while they fulfilled the requirements there was always a feeling that something better might be had. Now that electricity is available for such work, it is being rapidly introduced and most of the progressive manufacturers are adopting it.

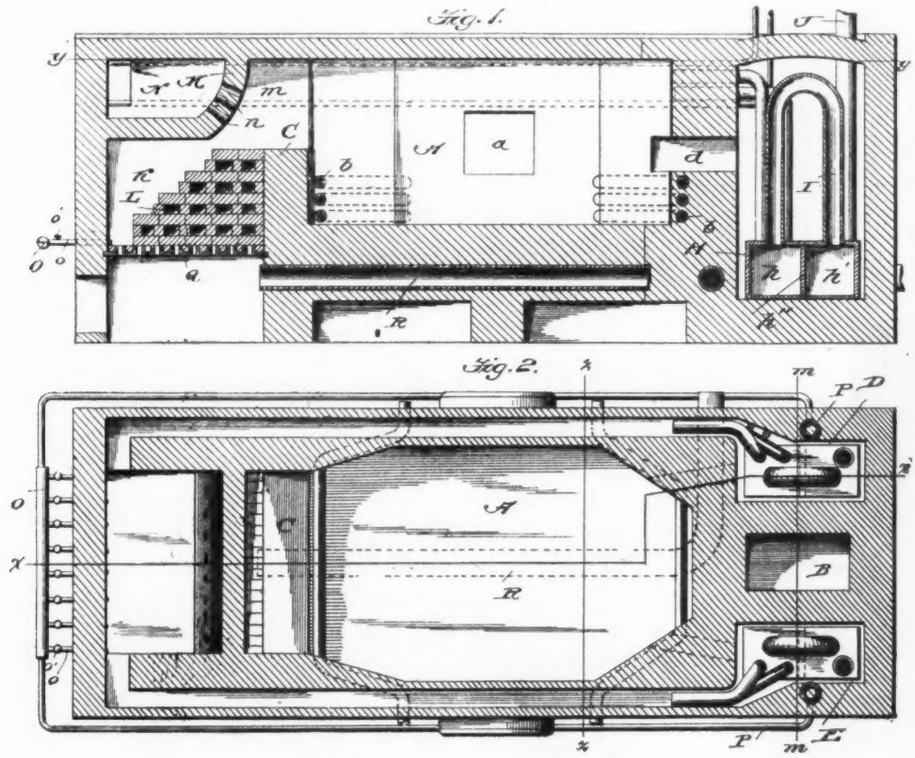
One of the most recent applications is shown in the illustration herewith, reproduced from a photograph. This is a 10-ton jib crane which was recently put in the Michigan Brass & Iron Works, at Detroit, Mich. Two of these cranes have been introduced, one having a capacity of five tons, and the one herewith. These cranes are equipped with motors of 10 and 15 horse-power respectively, and drive the hoisting gear through cut spur gears. The motors are specially fitted for crane use and are of the slow speed type, reversible, and the speed can be varied. The operator can easily control the movements of the load from the motor itself. A wire cable is used for hoisting and the racking is done by the hand wheel shown on the side of the crane near the base. The cranes are both so arranged that in case of accident they can be operated by hand power. These cranes were installed by the Detroit Foundry Equipment Co., of Detroit, which does a very extensive foundry outfitting business.



ELECTRIC JIB CRANE.

THE STUBBLEBINE FURNACE.

Wm. Stubblebine, of Bethlehem, Pa., is the inventor of a furnace which has been thoroughly tested in the past 18 months in various Pennsylvania iron and steel plants, and has thus established its claims to consideration, as a furnace consuming oil, oil gas, coal gas or natural gas. Though used mostly in the puddling of iron and in open-hearth work, it is adapted to smelting, to glass furnace work or to heating purposes generally. Previous to the issue of the patent on this invention, Mr. Stubblebine took out letters covering a reverberatory furnace with heating-chambers on opposite sides of the up-take and communicating by intermediate passages with the puddling chamber, combined with mixing flues which extend

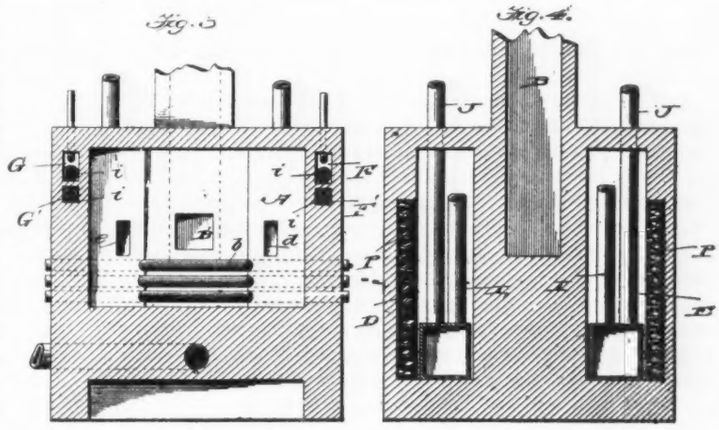


longitudinally of the furnace, one end of each mixing flue being connected to its heating chamber and the other end having a discharge port. These discharge ports commingled air and gases above the bridge wall and blast-pipes located in the heating chambers and discharging into the mixing flues.

In the device illustrated in this connection, in addition to employing the heating chambers mixing flues and blast-pipes, in about the same form as in the previous patent, the inventor has added appliances for burning liquid or gaseous fuel, commingling the gases and heat arising from combustion, with the current of commingled air and gases from the mixing flues, the two currents meeting over the bridge wall and entering the puddling chamber combined.

Of the illustrations, Fig. 1 is a vertical longitudinal view through the furnace, on the plane indicated by the dotted line *x x* of Fig. 2. Fig. 2 is a horizontal sectional view on the plane indicated by the dotted line *y y* of Fig. 1. Fig. 3 is a vertical transverse section through the furnace, on the plane indicated by the doted line Z Z of Fig. 2. Fig. 4 is a transverse section on the line *m m* of Fig. 2. A indicates the working chamber of the furnace; *a*, the door in one side; *b*, the chills in the bed of the working chamber; B, the uptake; B′, the neck leading from the rear end of the working chamber to the uptake; C the bridge wall at the front end of the working chamber. D E are the heating chambers, built in the masonry and located at the rear of the working chamber A and on opposite sides of the uptake B and neck B′.

F F′ and G G′ are the mixing flues, two of which are on the right-hand side of the furnace and the other two on the left-hand side. These mixing flues communicate at their rear ends directly with the heating chambers D E, and the front ends of the mixing flues discharge into a chamber at the front end of the furnace. In each of the heating-chambers D E is a blast-box H, located at or near the bottom, and each blast-box is divided into two compartments *h h′* by an intermediate vertical partition *h″*. The blast-pipe J enters the heating-chamber and discharges into the compartment *h* of the blast-box H, and from this compartment *h* the current of air or steam passes through the vertical air-pipe I to the other compartment *h′* of the blast-box, and from this latter compartment the air or steam is conducted by jet-pipes *i i* to the mixing flues. As the heating-chambers D E are in direct communication with the working chamber A by means of the passages *d e*, a portion of the heat and gases from the working chamber passes into the heating-chambers and circulates around the blast-box and the circulating-pipe I, whereby the blast of steam or air passing through the blast-box, the circulating-pipe, and the jet-pipes *i i* is heated before the air or steam is discharged into the mixing-flues. The jet-pipes *i i* terminate in the mixing pipes or flues at points a short distance in advance of the con-



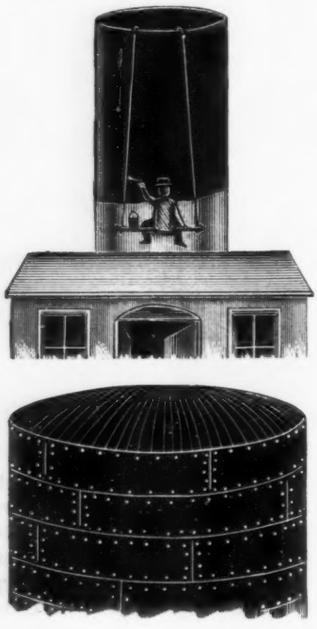
nection between the mixing-flues and heating-chambers, and as the rapidly-moving currents of air or steam from the jet-pipes are injected under pressure into the mixing-flues a part of the gases in the heating-chambers will be drawn into the mixing flues or pipes and thus insure the commingling of the heat and gases from the working and heating chambers with the air or steam blast while these currents are conveyed through the mixing flues or pipes to the front of the furnace.

In the front of the furnace is the combustion-chamber K

between the bridge-wall and the front wall of the furnace, and in this chamber is the checker-work L, built of brick in the usual form.

Above the checker-work L in the top of the furnace and in front of the bridge-wall is an overhanging arch M, which is so arranged that it forms between the roof and front of the furnace a chamber N, which extends transversely across the furnace in the upper front part so that the four mixing flues F F′ G G′ will open and discharge into this chamber the currents of commingled air or steam and gases. The rear wall of this chamber N is inclined or curved, as at *m*, so that it faces the heat passage over the bridge-wall, and this inclined or curved wall is perforated at *n* to permit the currents of commingled air or steam and gases to pass from the chamber into the working chamber A.

O is the fuel-supply pipe, arranged horizontally on the front wall of the furnace, being supported either a short distance from the face of the front wall, as shown, or embedded in the front wall. This pipe O is supplied with either liquid or gaseous fuel; but it is best to first raise the temperature of the fuel by passing through heating-coils P P, located in the heating-chambers D E, the coils being connected by pipes *p p* to the supply-pipe O. From this supply-pipe extends a series of branch or outlet pipes *o*, which lead through the front wall of the furnace, so as to discharge the fuel into the checker-work L. These outlets are of less diameter than the supply pipe to cause the liquid or gaseous fuel to enter the checker-work slowly and regularly and thus insure the proper combustion of the fuel.



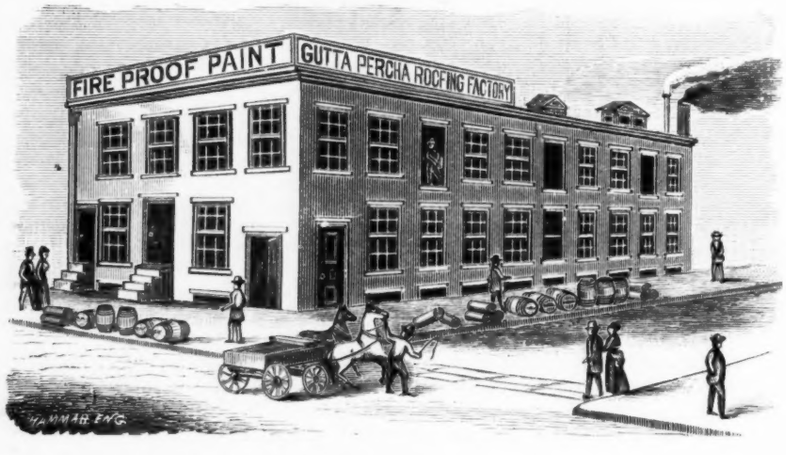
The operation of the furnace is thus summarized: The checker-work is heated in any convenient way, and the heat and gases from the working chamber pass through the passages *d e* to heat the chambers D E, the coils and pipes therein. The blasts having been started in the pipes J R, the gases in the heating-chambers are drawn into the mixing flues or pipes by the jets of steam or air, and said steam or air and gases pass through the mixing-flues into the chamber N. The fuel fed to the checker-work by the supply-pipe is vaporized and commingles with the blast from the pipe R, and the two currents of gases and air—the one from the chamber N and the other current from the checker-work—are commingled as they pass over the bridge-wall into the working chamber A.

Mr. Stubblebine's invention is known as the Eureka furnace. It has been adopted in the mills of the Bethlehem Iron Co., and the results have surpassed those attained by any gas furnace operated there. The working is similar to that of a direct gas furnace and the results are equally satisfactory with iron or steel. Tests show quicker heating than other furnaces, and that there is but 2 per cent. waste in the iron. In doing away with firing it is well liked by the men, dispensing with the disagreeable task of cleaning the grate after each turn's work. The Boonton (N. J.) Iron & Steel Co. and the Ferndale Rolling Mills report a saving of 25 to 30 per cent. in fuel by the use of Stubblebine furnace. Supt. Edwards, of the latter, notes a product of 48 gross tons of iron plate for 5½ days, with this furnace, and adds that it was not necessary to re-heat each pile. The hearth was only 11′ 6″ x 6′, but it was expected that this would be enlarged in the furnaces subsequently put in.

GUTTA PERCHA ROOFING.

The Empire Paint & Roofing Co., 111 N. Fourth street, Philadelphia, are the only manufacturers of gutta percha roofing in the United States. A superior quality of work is turned out by this company, and their product is not to be confounded with many imitations which are on the market. A heavy roof is not needed for a great number of buildings. It is to sustain no superstructure nor to be subject to extra weight at any time. A light roof answers every purpose, and offers many advantages. It does away with girders, braces and numerous other contrivances necessary to sustain a heavy one.

The gutta percha roof, besides being durable and substantial, is one of the most economical and easiest of application in the market. Cheap roofing does not pay. It may serve for a few years, but will cost more in the end than if better material had been selected. But as between good roofing cheap, and cheap roofing worthless, a decision can be made after inspecting samples this company will send upon application. Another merit of gutta percha is that it is the one roofing that will resist the acids and gases arising from iron works, foundries, etc. It will not last a lifetime, but it will last as long as the building to which it is applied, if it has the proper attention; that is, recoating about every three or four years, or the same care a metal roof requires. The gutta percha roof is not only cheap and durable, but light and practically fire-proof, easily applied by any intelligent employe of the purchaser. This company states that it has supplied its roofing to more iron works and foundries than other manufacturers in the United States combined, and produces references from large and responsible builders of iron works and foundry plants in this country. Its goods are heavy, solid yet flexible, no sticking at ends of rolls, but dry and clean, and would scarcely soil a white handkerchief by contact.



THE EMPIRE PAINT & ROOFING CO.

The Empire Paint & Roofing Co. also manufacture an elastic paint—brown and red, a good article for wood or metal surfaces. Its stack enamel is for coating smoke stacks, boiler fronts, etc., and it is claimed will last four times as long as cheap asphalt varnishes. The Empire Paint & Roofing Co. is composed of men who believe in giving value received.

The easy manner in which this roofing can be applied makes it a great advantage to the builder and the owner, to the builder, because he can quickly enclose the building, an advantage of considerable importance in a variable climate; to the owner, because he will be certain to put a similar roof upon any of his other buildings that may need it. No skilled mechanic is required and no extensive array of special tools. Any one who has mechanical skill sufficient to use intelligently a knife, a hammer and nails, can lay the roof in a satisfactory manner.

This company has recently issued an elaborate illustrated catalogue, which will be sent, accompanied by samples, to any one who will correspond with it.

CORE-MAKING—I.

BY SIMPSON BOLLAND.

Let us first consider the material needed for core-making. To insure success in this department requires skill in the selection of the different sands and their several mixtures. Districts widely separated will vary considerably in this particular, according to the kinds of sand nearest to hand, and their suitability, price, etc. The city of New York and vicinity are fortunate in having unlimited supplies of beach or white sand, which enters largely into the mixtures for general work. Especially is it well adapted for small jobbing cores, being very fine and easily worked, and, after being burned in the casting, giving little trouble to clean. But in the country, where white sand is out of the question, on account of the cost for carriage, the river-sands are used instead, with slight variations in the mixtures.

The next in importance is the coarse, sharp, or, as it is by some called, fire-sand, on account of the resistance it offers to the high temperature of the molten iron. This sand is valuable also because, being so open in its grain, it permits the gases formed during the process of casting to escape freely, or, as is most commonly said and understood by moulders, "the air comes off good." But good as these sands are, they would be valuless alone, because, containing little or no clay—as most other sands do—they will not hold together by the regular method of dampening and ramming. Consequently, in order to utilize them, we resort to artificial means to bring them up to the proper consistency. The most common things used for this purpose are flour, molasses, clay, resin, and glue. There are many other things used, but, for all practical purposes, I consider the ones mentioned will meet all requirements.

Moulding-sand is also used in the core-mixtures, to help them up to the required stiffness, on account of its possessing in a great measure the elements lacking in the white and fire sands; but, on account of its finer nature neutralizing the good derived from the openness of the fire-sands, it must be used only for the purpose of stiffening as before mentioned. The Albany and Waterford sands are chiefly valuable on account of their fineness, being graded from No. 1 up to the coarsest kinds. The No. 1 is used for the finest kind of work, such as stove, register, very light machinery, etc. But for the heavier kinds of jobbing and machinery work, the Jersey sands rank A No. 1, being of a tougher nature on account of the larger percentage of clay which enters into their composition. There are also three grades of this sand, the medium being the most useful. But, as this sand contains so much more clay, we need great care in its use. Its property of adhesiveness makes it valuable for the heaps and floor; but for the facing of patterns we have recourse to the mixtures before spoken of, these mixtures being required as well for the easier and safe working as for the purpose of conducting the gases from the surface of the mould. I shall say more on these subjects in their proper place, and shall now proceed with the subject of core-making, first giving a list of mixtures which I have proved to be the best for the work for which they are intended.

Core-sand Mixture No. 1.—10 parts white sand, 1 part flour, with water sufficient to make it work easily. No. 1 mixture is for small jobbing, round and square, and all cores not too large, and where the iron, in pouring, does not strike the core. A little water sprinkled carefully over the cores before putting into the oven will give a harder skin.

Core-sand Mixture No. 2.—7 parts white sand, 3 parts fine Jersey moulding-sand, 1 part flour, with water sufficient. No. 2 mixture is for cores requiring a little tougher sand, and will cling together better than No. 1, enabling you to bring up the edges good, and is suitable for small port-cores for cylinders, pumps, etc. Sometimes I have found it necessary to change these mixtures to suit intricate jobs having very thin cores in them, and difficult to vent. In such cases I have, after failures with mixtures Nos. 1 and 2, had recourse to the following, never knowing them to fail in cases where the proper precautions were taken to make and secure the vents.

Core-sand Mixture No. 3.—10 parts white sand, 5 parts moulding-sand, 2 parts No. 1 mixture, 2 parts resin (ground very fine). Mix with water, and sprinkle a little weak molasses-water on cores.

Core-sand Mixture No. 4.—Mix thoroughly, when dry, half and half river-sand and fire-sand, sift through a fine sieve; then to 15 parts of mixed sands, add 1 part of resin, ½ part of flour, and mix with weak molasses-water.

Core-sand Mixture No. 5.—8 parts fire-sand, 2 parts Jersey moulding-sand, 1 part flour. Mix with thick clay-water. No. 4 is a good substitute for the "white" sand mixtures. No. 5 is an excellent mixture for larger cores, and is the best dry-sand facing for any ordinary work, such as cylinders, pumps, etc., up to 40 inches diameter, requiring very little venting if thoroughly dried. It is also suitable for large pipe and other cores, for which the other mixtures are not suited, on account of the tendency of the white or river sand to melt or scab. Pipe-cores made of No. 5 mixture will enable the moulder to gate or run his casting on the top—an absolute necessity sometimes where a sound casting is required. I need not give any more mixtures for core-sands, as a slight modification of the above will enable the core-maker to meet all demands on his ingenuity.

Loam Mixtures for Cores on Barrels.—Where the loam must be made by hand, the mixture is 5 parts fire-sand, 2 parts Jersey moulding-sand, 1½ parts manure. Thick clay-wash to suit. If ground in the mill, the ingredients will be: 7 parts fire-sand, 2 parts moulding-sand, 2 parts manure. Thick clay-wash. The reason for the increase of fire-sand and manure is that the mill grinds the ingredients into a finer mass than they can be mixed by hand; therefore, to preserve the openness required, more fire-sand and manure are added; but care must always be taken not to grind the mass longer than is necessary to mix it well.

Rigging for Cores.—Another important item in core-making is the rigging for securing, venting, transportation, etc., and to be able to make the best use of such tackle as may be on hand, as well as to get up new arrangements if actually needed. I have frequently seen immense waste of time and money caused by the elaborate nonsense of some would-be-genius, who, if he had looked carefully into the job, would have been able to do it twice over with the rig he had around him, and in much less time than it took him to use the complications he had pondered out.

To begin with, we will take a very simple example—that of a flat core 2 feet long, 1 foot wide, and 6 inches thick. Suppose it stands out of the mould at each end 3 inches; except at the ends, metal is supposed to cover the whole of the core. Now, all we have to do in this case is to secure the sand with rods both ways and take the vent out through the ends, as at Fig. 1. Such a core as this would require No. 5 mixture. Now, this is a very ordinary core to make, but, retaining the same width and length and changing the depth, we shall meet new necessities. Let us suppose our cores to be 24 inches

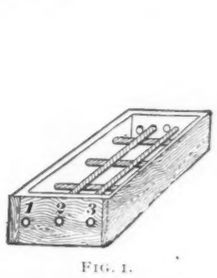


FIG. 1.

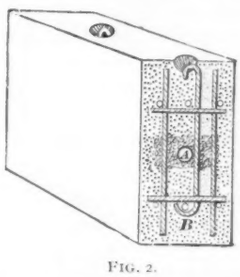


FIG. 2.

deep, and we find that we must tie our core in its depth as well as in its width and length. Better provision must also be made for carrying off the gas than is shown at Fig. 1, as the three holes, 1, 2, 3, will not be sufficient for that purpose. Allowing that we have nothing but rods to make our core with, we must put in two sets of irons, six inches from each end of the core, in the same manner as shown at Fig. 1, and also ram up other irons on end, to tie the core in its depth.

To lead off the gas, we either increase the number of holes, or what is better, we can in this case have a hole in the center 1½ inches diameter, through which a bar can be put, and, after ramming up to the vent-rod and venting down to the bottom of the core, cinders must be placed to the depth of 3 or 4 inches, taking care that they do not come to the outside. After ramming the remainder, vent down to the cinders. It will be readily seen that by this method every part of the core is reached by the vent-wire, and consequently the gas will

freely escape through the one large hole in the middle, as *A*, Fig. 2. Another advantage in limiting the number of vent-holes is that the moulder can secure his work more readily and securely. Now, as this core cannot be as easily handled as the smaller one, some provision must be made for lifting it into the mould; and, as we have supposed that our core comes through at the ends of the mould, a hole may be made, through which a bar can be passed, or hooks may be rammed up in the core, taking hold of the bottom irons or rods.

Fig. 2 shows section of core where the book *B* comes, and explains at a glance the different instructions given. Let us now suppose that our core is 1 inch thick, and we at once see that our room for rods and vents is very limited. We must in this instance be careful to have the vents evenly divided, a little below the half. The vent-rods and long irons being placed after ½ inch of sand is rammed in, the short rods to tie the whole together can be laid across, and the ramming completed. Care must be taken in drawing the vents, or the core will be split. We have, in this case, something to contend with which does not occur in the other cores. The rods cannot exceed ¼ inch diameter, and, being so much weaker, will require more careful handling. We must remember, also, that being so much shallower than the others, the iron in pouring will cover the core quicker, and the vents, being so much smaller, cannot convey the gases away as fast as they should do, especially so when the core is very hard. To overcome this difficulty, it is best to make all this class of cores in fire-sand alone, mixed with molasses water of medium strength. This leaves the sand very porous, and there will be no difficulty.

But should it occur that the cores we have been speaking of had the iron cast on all six sides, we must then adopt another method to carry off the gas. In the case of a core 6 inches deep, we pass other vents connecting with those running through the length of the core, and connect these with the

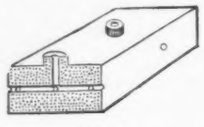


FIG. 3.

place where we are to take off the vent (which is usually on the top) by as large a hole as possible. Fig. 3 shows the position of vents, which, when all is clear and free, are stopped securely on the outside. In the case of the core with cinders, we simply place upright vents leading from the cinders to wherever the gas is to be taken away.

It may be here stated that where you have only very small holes through which the core must be taken when cleaned out, there must be as few irons used as possible, and no wrought iron where cast will do. In some jobs, where the core is not too large, sticks of wood may be used to stiffen the core, and where this can be done with safety, a great amount of trouble is saved in the cleaning.

The Allis Engine at the World's Fair.

The monster Allis engine for the World's Fair is now being completed, and it is the greatest work of the kind ever done. The engine, which weighs, independent of boilers and attachments, 325 tons, will require about 20 freight cars for its transportation from the works of the E. P. Allis Co., at Milwaukee, to the Fair. The normal capacity of the Allis engine is 2,000 horse-power, but under pressure it will develop 3,000 horse-power. It will be used to run two dynamos, each connected with a line of 10,000 incandescent lights, 16 candle-power, and if it ever becomes necessary it can run an additional 10,000 lights. The arrangement of the belts connecting the engine to the dynamos is interesting. Two six feet belts are to be used, one running on top of the other, an arrangement common enough in small machines, but never before employed for a big engine.

THE largest shaft ever forged in the United States was sent from the Bethlehem Iron Works to the World's Fair last week. It weighs 89,320 pounds and will be the axle of the great observation wheel, 264 feet high.

HAS a growing constituency—*The Iron Trade Review.*

TWENTY-INCH UPRIGHT DRILL.

The illustration presents the Prentiss Tool & Supply Co.'s 20-inch upright drill, with stationary head. Its special features are its back gears and power feed, with quick-return motion to the spindle. If desired, it can be made with back gears only. The height of the drill is 6 feet 3 inches and its swing is 21 inches. The diameter of the column is 5½ inches; diameter of steel spindle, $1\frac{5}{16}$ inches; diameter of table, 18 inches; diameter of driving pulley, 9 inches; width of belt on driving pulley, 2 inches; width of belt on cones, 2 inches; largest sizes of cone, 9 inches; greatest distance from spindle to base plate, 42 inches; greatest distance from table to spindle 27 inches. The lower shaft has a speed of 270 revolutions.

Care has been taken, the makers state, to so proportion the different parts that they will correspond, each to the other, to secure strength and solidity, and be of easy and accurate operation. The spindle and shafts are made of steel, and all gears and racks are cut from the solid. The spindle is balanced by

weight in the column. The weight of the drill complete is 700 pounds.

The Prentiss Tool & Supply Co., makers of the above drill, may be addressed at 59 S. Canal street, Chicago, or 115 Liberty street, New York.

Leaking Roofs at the World's Fair.

A great deal of trouble has resulted at the World's Fair, from the leaking of the roofs on some of the principal buildings. Exhibitors have complained a great deal because their exhibits cannot be placed in the buildings without getting wet, and Director-General Davis has issued an order to prevent the installment of exhibits in leaking buildings until the roofs have been repaired. The roof of the Manufactures Building is in very bad shape, and Agricultural Hall is about as bad. Director of Works Burnham says the leaks will be stopped in a few days, as soon as the glass is received with which to mend the roofs.

THE Elba Iron Works, near Pittsburg, have posted a notice of a reduction in wages. Puddling will be $5 and reductions have been ordered in the pipe and other departments.

NEW UNIVERSAL MILLING MACHINE.

The Cincinnati Milling Machine Co., of Cincinnati, O., are making the manufacture of milling machines an exclusive specialty, and build a complete line of high grade tools of modern design. We illustrate their latest machine, which they denominate their No. 1 Universal tool room milling machine. Its distinctive feature is the circular form of the swivel housing. This not only adds to the appearance of the machine, but is of practical value when cutting spirals or doing any work requiring swiveling of the table. The saddle holding the table need not be withdrawn from the face of the column to the same extent, to prevent striking, as is necessary when the housing is made square. For the same reason a shorter cutter arbor can be used, both points adding to the rigidity of the machine under cutting operation. The manner of clamping housing and saddle together is new and effective. A T slot is turned in the swivel housing, and by means of two T bolts on either side, this piece is firmly held to saddle and can be absolutely locked. The clamping bolts are stationary and of easy access. The idex for angles of spirals is placed on the outer periphery of the swivel housing, and this being of large diameter permits a coarse graduation and a consequent fine adjustment.

The column is of an improved pattern with a cylindrical brace between the two upright supports of overhanging arm. It is substantially braced throughout, and has a wide bearing on its face for the knee.

The knee is of the standard pattern with long bearing on face of column. The oblique placement of shaft for elevating and lowering same, in connection with permanent handles on screw operating the cross feed, and the screws in table, facilitates the adjustment and operation of the machine, as the operator has control of every adjustment without shifting handles or changing his position.

The table is six inches wide and 33 inches long. It feeds and trips automatically in either direction, right or left, and at any angle, without crossing feed belts. It is also provided with a quick return motion of three to one. The feed is driven by means of bevel gears and splined shafts, is very positive, yet can be easily released. The trip operates through the V-shaped dog and horizontal lever, and does not tend to lift table away from its bearings, as is the case when a vertical stop pin is used.

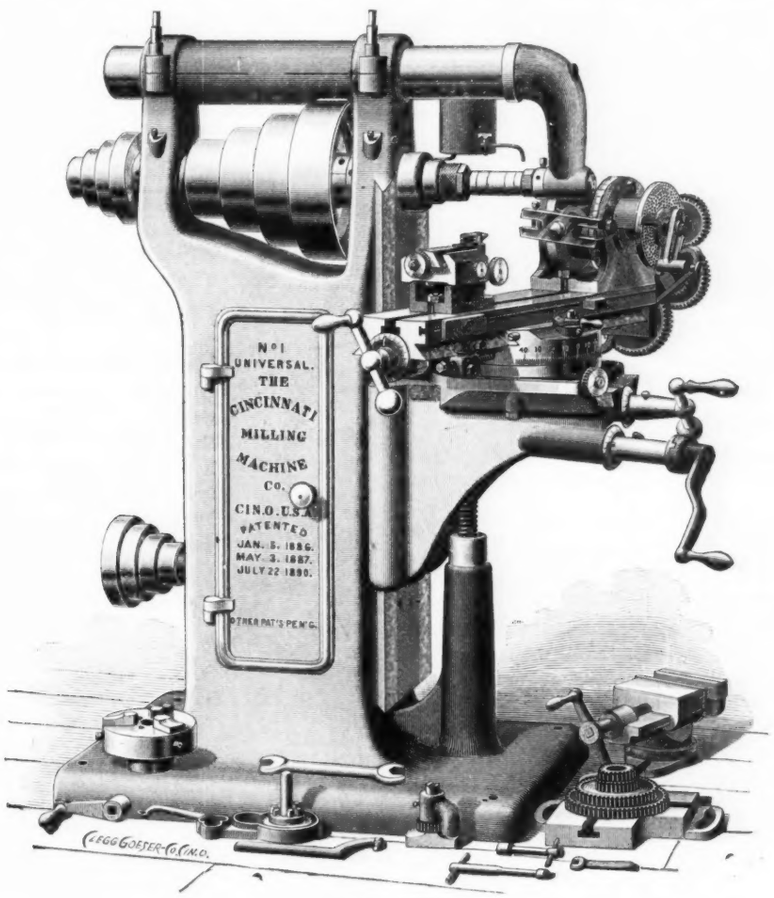
The overhanging arm is 3¾ inches in diameter, and, extending through the entire length of cylindrical brace, forms a rigid support to the outer end of the cutter arbor. It is provided with a hardened steel bushing, which, in connection with hardened bearing on end of cutter arbor, is a good substitute for the old fixed center which caused continual trouble by cutting.

The spindle is made of steel, 3¼ inches in diameter, and has phosphor bronze bearings. The front bearing is a taper one while the back bearing is straight. An adjustable lock nut is provided on the back of front box for taking up wear. An ¾ inch hole is bored through the entire length of spindle. The driving cone pulley is 12 inches in diameter and has four steps for three-inch belt.

The Universal indexing and dividing head furnished with this machine swings 10 inches in diamater. It has the patent tail block and elevating center for taper work. The dividing head has the feature of swiveling to either side of a vertical line.

The vise swivels and has a graduated base. The jaws are six inches wide, $1\frac{7}{16}$ inches deep, and will open 3¾ inches. The jaws are open on the side for holding work in an upright position. The countershaft is furnished with two friction clutch pulleys.

All plane sides on the machine are accurately scraped and fitted, cylindrical and conical bearings being ground on the universal grinding machine.



NEW UNIVERSAL MILLING MACHINE.

Change in a Cincinnati Firm Name.

On Feb. 1, Messrs. Anton Mill and August H. Tuechter were admitted as partners in what has been known for many years as the Bickford Drill Co., of Cincinnati. The new firm is now the Bickford Drill & Tool Co., and the business will be continued under the latter name. Appreciating the generous patronage of the past, the firm offer their record of prompt and careful attention to all business entrusted to them as a warrant for the future.

ENGLAND made 6,616,890 gross tons of pig iron in 1892.

BRAINARD UPRIGHT MILLING MACHINE.

The two illlustrations on this page are of the Brainard No. 20 upright plain milling machine. It is one of the heaviest of

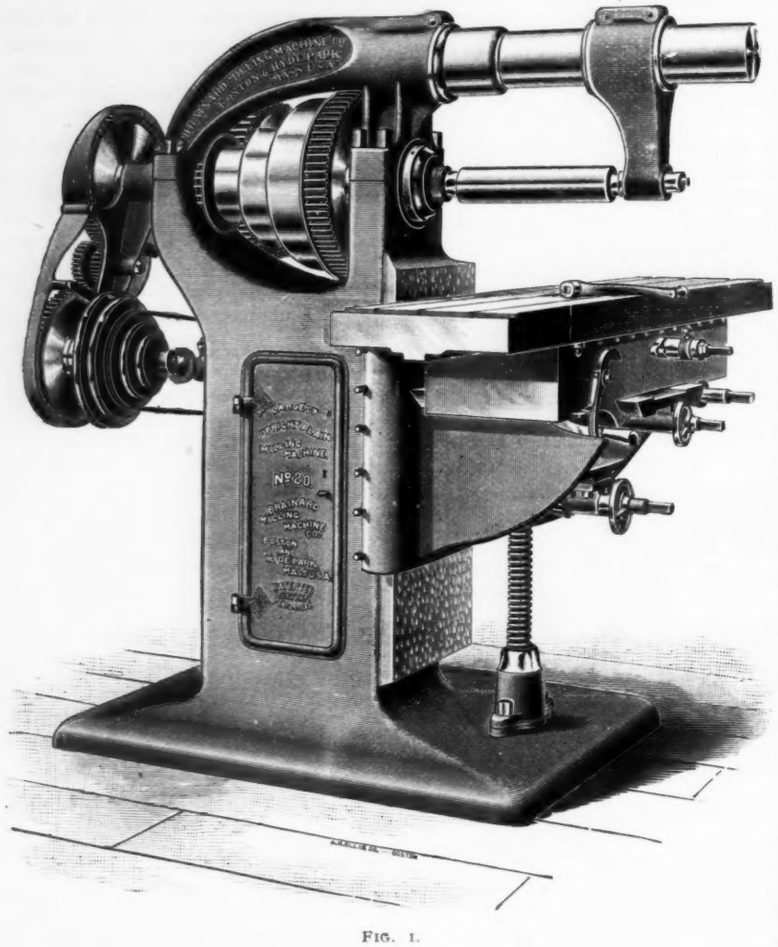


FIG. 1.

the universal type and is designed for heavy work. Several new attachments merit a word of special description:

The length of the automatic feed is 72 inches; the vertical range of table, 24 inches; cross motion of the carriage in line with the spindle is 11 inches; the length of the carriage in which the table has its bearings is 4 feet; width of the table 16 inches; length of the table over all, 78 inches; weight of the machine without attachments, 7,400 lbs. The cone has 12 changes of speed and there are 10 changes of feed for each speed of the cone.

In Fig. 2 the outline cut of this machine is shown the new rotary attachment, which can be used for indexing large circular work, or can be arranged to revolve automatically for milling various kinds of circular work.

On the ends of the table in this outline cut are shown the jaws of the new style of vise, which will take in between the jaws nearly the full length of the table. The jaws are 13 inches long, are steel face, and are very convenient for holding long work.

Complete details of this new machine can be obtained from the Western agents, Messrs. Hill, Clarke & Co., 12 and 14 South Canal street, Chicago.

Ætna and Standard Companies Consolidate.

Plans for the consolidation of the Ætna Iron & Steel Co. and the Standard Iron Co., whose plants adjoin each other, at Bridgeport, O., and large interests in which are held by the same people, have been consummated, and now require only a formal vote of the stockholders. The name of the new company will be The Ætna-Standard Iron & Steel Co., capital $2,300,000, divided into $1,500,000 of preferred stock with 8 per cent. guaranteed and $800,000 common stock; $1,200,000 of the preferred and $800,000 of the common stock will be issued in payment for the two plants, and $300,000 held for improvements. A charter will be taken out in West Virginia. A feature of the financial plans is the setting aside of an amount not exceeding 2½ per cent. of the capital stock, each fiscal year, as a contingent fund, to be accumulated until it shall be not less than $100,000 and not more than $200,000.

The new concern will be the largest producer of sheets in the world and by far the largest in the United States. The equipment will consist of fifteen sheet mills and four bar mills. Eleven of these sheet mills are engaged in the production of light sheets and four on heavy sheets. A more extensive variety of products will be made in the Ætna-Standard than in any other mill in the country. Included in its output will be corrugated sheets, galvanized sheets, and iron and steel sheets in all qualities, gauges, and sizes. The bar product will consist of common bars, all sizes, angles, tees, channels, light rails and other shapes. About 1,200 to 1,500 men will be employed and the total gross tonnage will be about 75,000 to 80,000 tons of manufactured products annually. There is some talk of the erection of a Bessemer steel plant.

The officers of the Ætna company are W. H. Tallman, president; John A. Topping, secretary and treasurer; B. M. Caldwell, manager. The Standard company's officers are L. S. Delaplain, president, and W. T. Graham, secretary.

THE machine shops of the Penokee and Gogebic consolidated mines at Ironwood, Mich., were burned on Thursday, March 23. Everything was destroyed, including the pattern house with many valuable paterns of machinery. The loss is $14,000 and the insurance $10,500.

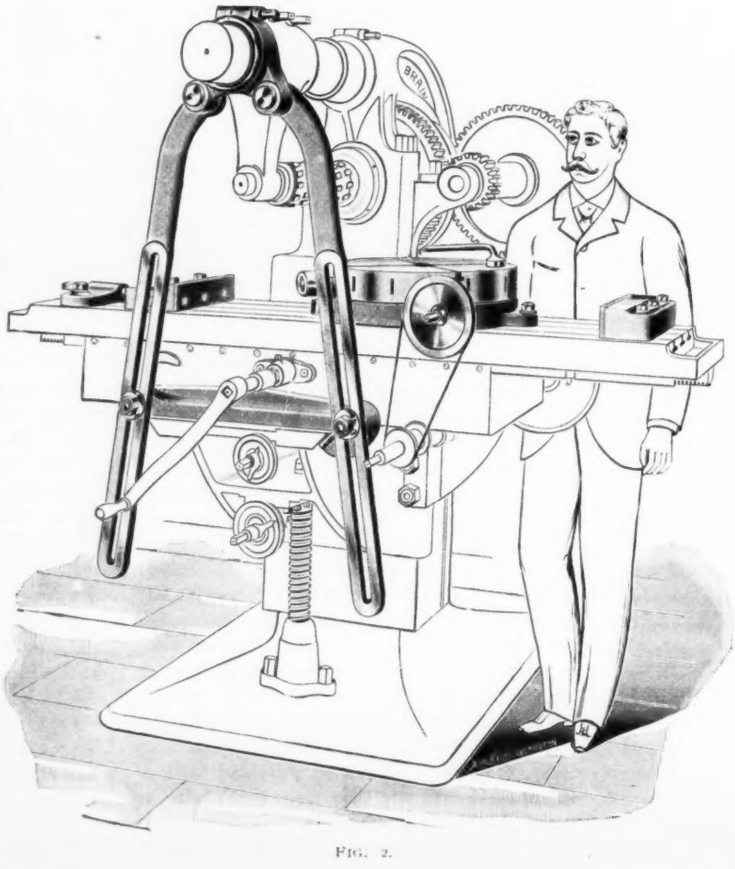
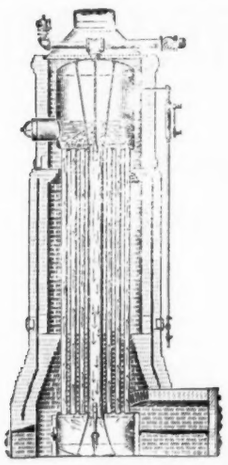


FIG. 2.



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INDUSTRIAL SUMMARY.

New Enterprises:—

The following recent incorporations, specially reported for *The Iron Trade Review*, are of interest to the iron and machinery trade:

Chicago, Ill.—Star Electric Lamp Co.; capital, $25,000; to manufacture and sell electric lamps; incorporators: Walter J. Gunthorp, L. V. Willey, J. Elliott.

Milwaukee, Wis.—The Standard Car Co.; capital, $100,000; for general manufacturing, foundry and machine shops, etc.; incorporators: A. Merrill, E. Dederick, F. N. Merrill.

Chicago, Ill.—The Watson Down-Draft Furnace Co.; capital, $10c,000; to manufacture and deal in down-draft furnaces; incorporators: Edwin J. Noble, Geo. F. Westover, M. W. Geisinger.

Decatur, Ill.—H. H. Brown Mfg. Co.; capital, $20,000; to manufacture and sell hardware and do a general manufacturing business; incorporators: Henry H. Brown, Chas. H. Brown, Albert M. McGee.

Bloomsburg, Pa.—Mears Mfg. Co.; capital, $30,000; for the monufacture of iron or steel, or both, or of any other metal, etc.; incorporators: Camden Mears, Jno. W. Mears, C. W. Miller, Bloomsburg, Pa.

Chicago, Ill.—Coal Saving Grate Co.; capital, $50,000; to manufacture and sell grates patented by Canadian Government to Henry Petersen; incoporators: Henry Petersen, Carl H. Leopold, J. Henry Kraft.

Rochester, N. Y.—Rochester Fire Appliance Co.; capital, $1,000; for the manufacture and sale of appliances for the extinguishment of fires; incorporators: Henry H. Love, Wm. K. Barlow, Geo. A. Pierce, Rochester, N. Y.

Clayville, N. Y.—Hubbard, Babcock & Millard Axe Co.; capital, $40,000; for the manufacture of edged tools, etc.; incorporators: Jno. U. Hubbard, Clayville, N. Y.; H. Lee Babcock, New Hartford, N. Y.; Wm. J. Millard, Clayville, N. Y.

Chicago, Ill.—The Althouse Automatic Car Coupler Co. of the United States and Canada; capital, $3,000,000; to manufacture and sell car couplers and supplies for railways; incorporators: Harry Vincent, Wm. Bammermon, Jno. C. Amendt.

Cambridge City, Ind.—Cambridge City Cycle Co.; capital, $50,000; for the manufacture and sale of the pneumatic sulky bicycle attachments, and the repairing of bikes and bicycles; incorporators: John R. Bond, Matt Shew, John A. Wilde, Cambridge City, Ind.

Cleveland, O.—The Cleveland Mechanical Stoker & Engineering Co.; capital, $25,000; for manufacturing and selling mechanical stokers, engines, etc.; incorporators: Alfred G. Hathaway, E. J. Leighton, Chas. Hathaway, Jr., Geo. A. Armington, Harvey D. Goulder.

Cleveland, O.—The Union Fnrnace Co.; capital, $5,000; for selling, erecting and dealing in furnace and heating apparatus, and for doing a general tinning and roofing business, etc.; incorporators: I. M. McMullan, Joseph F. Kernan, S. Q. Kerruish, John Toole, W. D. Kerruish.

Philadelphia, Pa.—The Enterprise Mfg. Co. of Pennsylvania; capital, $1,600,000; for manufacturing all kinds of hardware machinery, metal castings, electrical appliances and all other articles from metal or wood, or both; incorporators: T. Henry Asbury, Lewis W. Klahr, Jonathan Seltzer, all of Philadelphia, Pa.

Connersville, Ind.—The Connersville Blower Co.; capital, $75,000; to manufacture, own, control, lease and sell machines for planing or producing cycloidal surfaces directly or indirectly, and to acquire, own and control patents therefor; also to manufacture, repair and sell blowers, air and gas exhausters, pumps, motors and other machinery, or parts thereof; incorporators: Jno. T. Wilkin, Jos. E. Huston, Robt. T. Huston, Jno. B. McFarlan.

New Buyers in the Market, and Some of Their Wants:—

[If you are in need of machinery of any description, please notify *The Iron Trade Review* and we will put you in communication with our advertisers at once.]

The Andrews Wire & Iron Works, of Rockford, Ill., are building a factory 30x60 feet, four stories high, and a one-story building 56x16 feet. They will manufacture wire work of all descriptions, wrought iron fencing, balcony railing, etc. They will be in the market for equipment, but have not yet decided definitely as to their wants.

The American Safety Lamp & Mine Supply Co., of Scranton, Pa., H. B. Smith, manager, will manufacture safety lamps for testing and working in gas, brass valves, cocks and a full line of brass goods, pneumatic signals for mines, brattice anemometers and mine supplies. They have a building 200x40 feet,

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and expect to fill orders in April. They will purchase drills, drop press, dynamo, electrical machinery, emery wheels, ejectors, injectors, files, fire brick and clay, foundry supplies, lathes, gear cutters, heater and purifier.

Additions, Enlargements, Removals, Etc.:—

The Vulcan Iron Works, Toledo, O., will spend $100,000 on a new plant at North Toledo, within the year. The present works are overcrowded, owing to the rapid growth of the business and the new plant will be much larger.

As a result of the consolidation of the National Cash Register Co., of Dayton, O., the cash register portion of the business of the Lamson Consolidated Store Service Co., of Boston, and the Kruse Cash Register Co., of New York, (both the latter companies continuing to manufacture other specialties) the Dayton plant will build an addition practically doubling its capacity.

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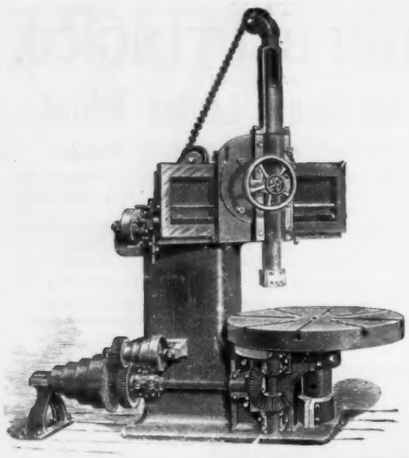

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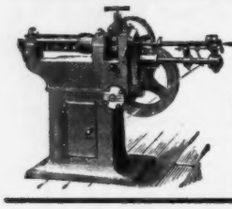

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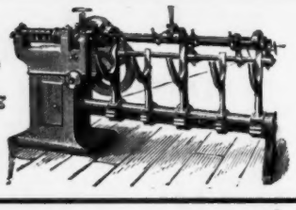

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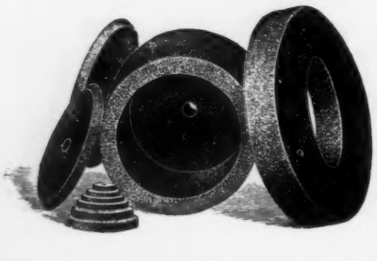

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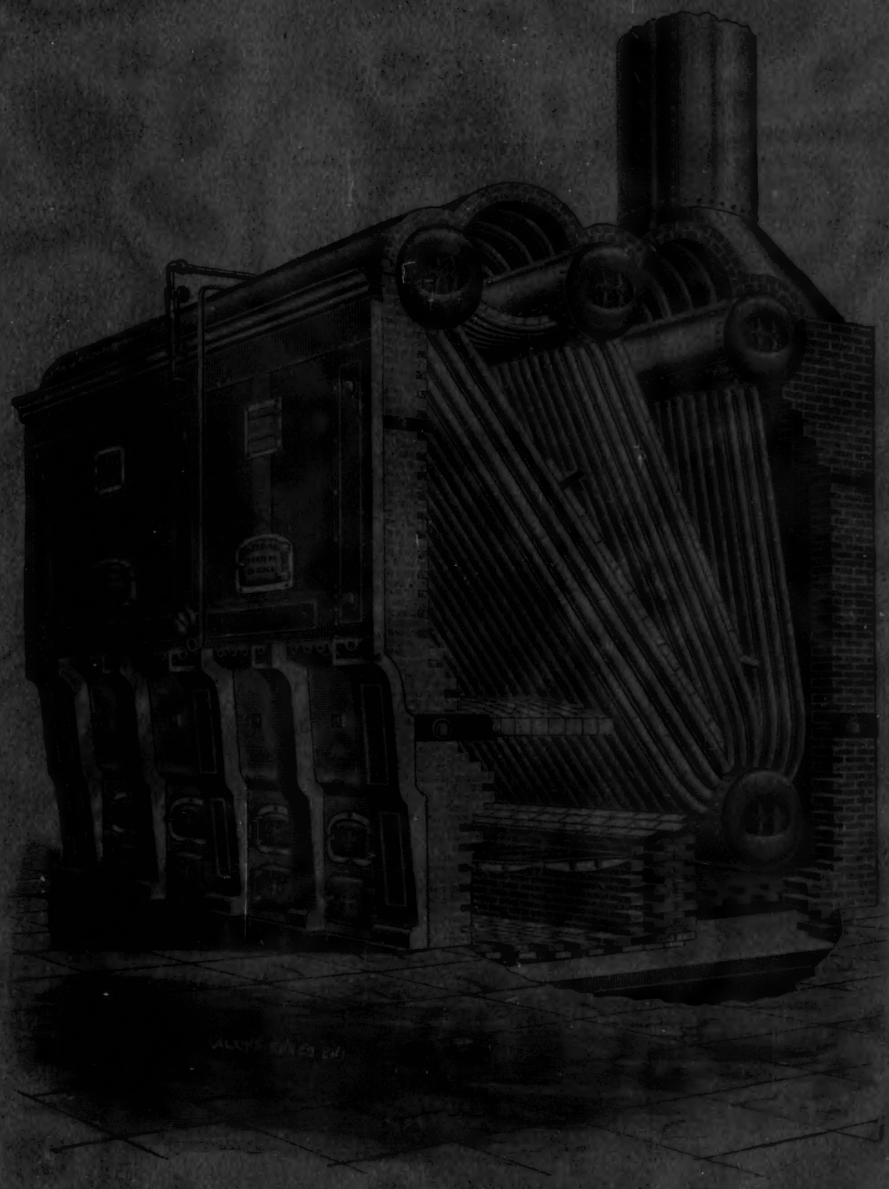

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[OVER.]

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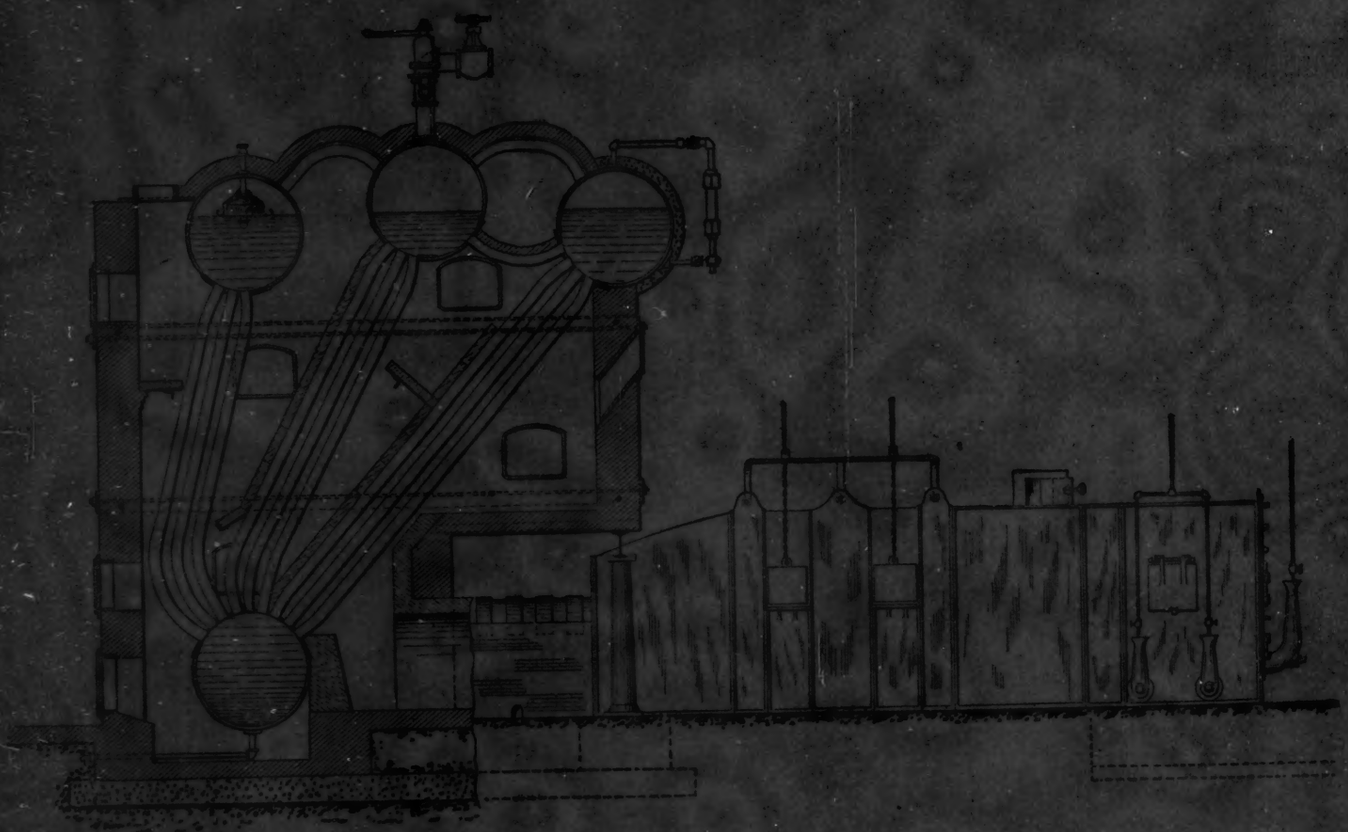

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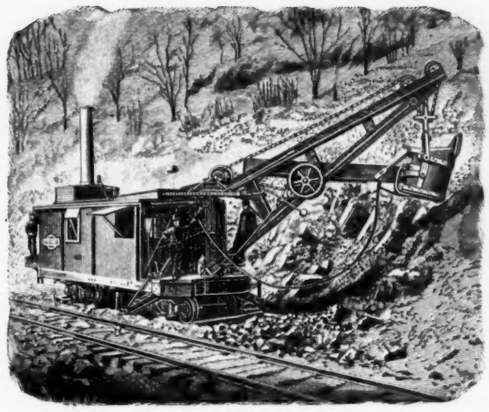

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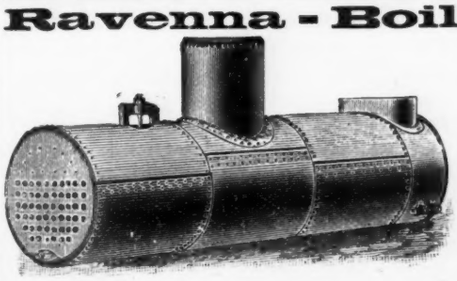

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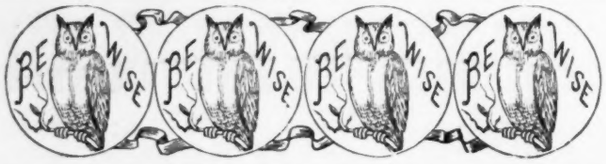

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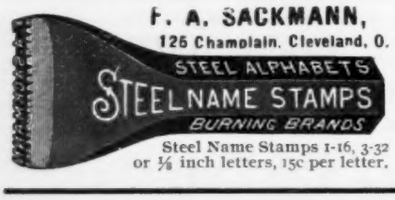

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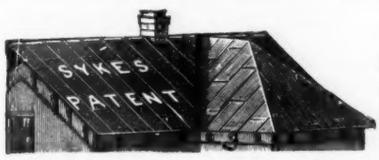

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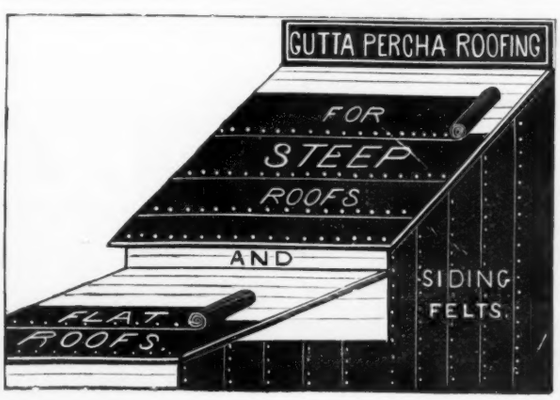

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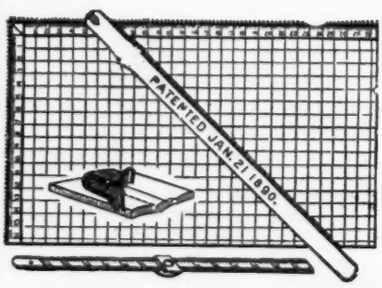

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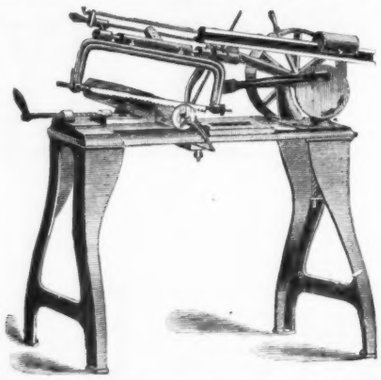

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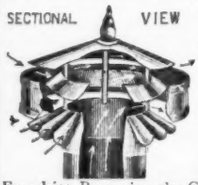

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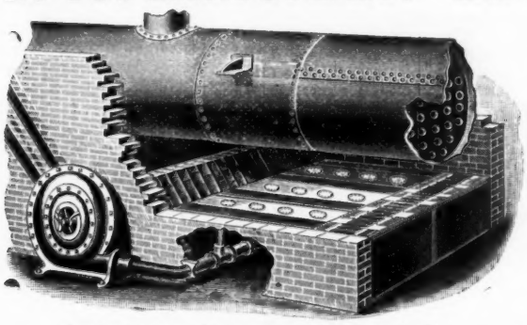

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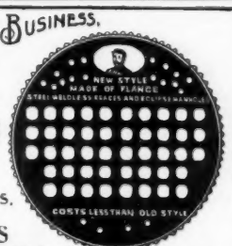

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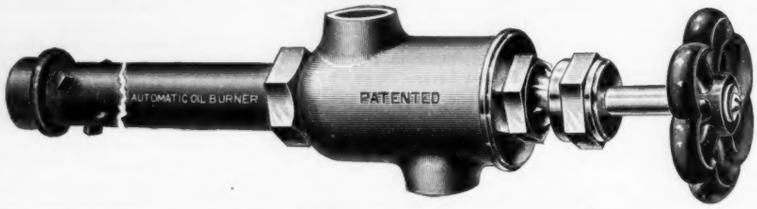

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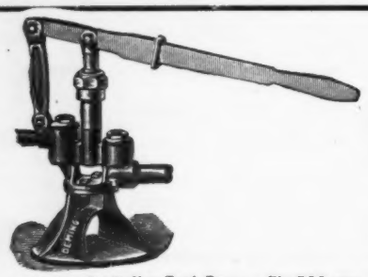

Hydraulic Boiler Test Pump. Fig 566.

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Alphabetical List of Advertisers.

The star (*) indicates that the adv. appears alternate weeks; the dagger (†) once a month; the double dagger (‡) once in three weeks; the parallel (‖) three times out of four.

	PAGE
Aitchison, Rob't Perforated Metal Co	25
Adt, John & Son	26
Akron Belting Co	25
Akron Tool Co., The	39
Aurora Tool Co	27
Aultman Taylor Mfg. Co	23
Aetna Iron & Steel Co	30
American Injector Co	2
Bickford Drill & Tool Co	26
Bischoff, F. F. & Co	40
Babcock & Wilcox Co	40
Berger Bros	27
Bradley Fertilizer Co	33
Brightman Stoker Co	25
*Berger Mfg. Co	28
†J. V. Burke	—
Biedler, Frank R	28-37
Bremer, Godfrey J	39
*Beckett Smoke Consuming Co	39
Bucyrus Steam Shovel & Dredge Co	27
Callender & Patterson	39
Canadian Manufacturer	30
*Chicago, Milwaukee & St. Paul Railway Co	27
*Cleveland Desk Co	36
*Cleveland Electrical M'f'g. Co	—
Cleveland City Forge & Iron Co	1
Cleveland Twist Drill Co	40
Cleveland Iron Mining Co	25
Cleveland Stamping & Tool Co	27
Cleveland Rolling Mill Co	33
Condit Fuller Co	25
*Copeland & Bacon	26
Colliau, Victor	38
Cole, J. Wendell	40
Chester Steel Casting Co	31
Corrigan, Ives & Co	25
Canton Saw Co., The	30
*Cincinnati Milling Machine Co	—
Comstock, L. K	40
Correspondence School of Mechanics	30
*Curtis Steel Roofing Co	28
Deming Co	31
Detroit Foundry Equipment Co	27
Downerd & Son Co., The J	39
Dixon, Jos. Crucible Co	31
Dreier, I	37
Eclipse Electrotype & Engraving Co	40
*Eagle Lubricator Co	—
Eller & Co., J. H	28
Empire Paint & Roofing Co	29
Fay & Egan Co., J. A	35
Fleharty, J. H. & Co	38
Fulton Steam Boiler Works & Foundry	37
Garden City Sand Co	23
General Engineering Co	24
Graves Elevator Co	30
Gerlach, Peter & Co	25
*Golley & Finley Iron Works	39
Gilbert & Barker Mfg. Co	34
Gordon Hollow Blast Grate Co	34
Haldeman & Co., N. A	29
Harrington & King Perforating Co	38
Hill, Clarke Co	36
†Higley Sawing & Drilling Machine Co	—
*Hodell, H. H. & Co	—
Hartford Steam Boiler Insp. & Ins. Co	29
Hercules Powder Co	36
Hunt & Co., Robert W	3
*Illinois Central R. R	—
Iron Clad Paint Co	27
Industry File Works	40
Jones & Co., B. M	2
Jones, E. H. & Co	40
Jeffrey Mfg. Co	1
Jenks, James	38
Juvinall & Co., C. D	34
Kilbourne & Jacobs Mfg. Co., The	2
*Lake Shore Iron Works	—
*Leffel Co., W. C	39
*Lake Co., J. H. & D	—
Leofred, A	25
Lloyd Booth Co	35
Lord, G. W	30
Lawrence & Co., W. W	31
*Lunkenheimer Co., The	26
*Merchant & Co	—
Milton Mfg. Co	30
Magnolia Anti-Friction Metal Co	1
†Millers Falls Co	—
Muncie Land Co	30
Murdock, Jr., Jas	26
National Photo-Engraving Co	31
*Nanz & Co., A	37
New Castle Steel Castings Co	29
*Niles Iron & Steel Roofing Co	—
*Northwestern Land & Coal Co	39
Obermayer Co., The S	1
Outhwaite, J. H. & Co	25
Oglebay, Norton & Co	25
Otto Gas Engine Co	38
Parker, Richard A	25
Pemberton, Geo	38
Pope, E. C	25
Penberthy Injector Co	40
Penfield & Son, J. W	26
Pollock, Wm. B. & Co	2
Porter Iron Roofing & Corrugating Co	28
Pool, F. J. & H. R	1
Prentiss Tool & Supply Co	26
Quint, A. P	40
Ravenna Boiler Works	27
Rau Manufacturing Co	36
†Rayfield, E	—
Rainey, W. J	2
Rippel & King	25
Roberts Foundry Co., F. E	33
Sargeant & Co	25
Sykes Iron Roofing Co	29
Sackman, F. A	28
Stirling Co	39
Stilwell & Bierce Mfg. Co	2
Shepard, H. L., Agent	40
Skinner Engine Co	38
‖Sharon Fire Brick Works	1
‖Stowe Fuller & Co	1
*Spicer Mfg. Co., The	—
L. Spence & Son	2
J. J. Shepard	40
Sidney Machine Co	40
Springfield Emery Wheel Co	26
South Chicago Foundry Co	23
Sturtevant B. F. Co	35
Slocum, J. C	1
Taylor & Boggis Foundry Co	1
Toledo Machine & Tool Co	35
Tod, Wm. & Co	38
Totten & Hogg Iron and Steel Co	37
*Trenton Iron Co	37
Upson Nut Co	38
Union Electrotype Foundry	29
Union Mining Co	24
*Variety Iron Works	—
Van Duzen Gas Engine Co	2
*Warren Webster & Co	—
Waukegan Iron & Steel Casting Co	24
Wells Engine Co	31
Weston Engine Co	1
Whitman & Barnes Mfg. Co	24
*Wilhelm & Co	—
Worthington, Henry R	25

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[On Lake Erie docks.]

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No. 1 Specular, Bessemer	4.50@ 5.00
No. 1 Bessemer hematite	3.85@ 4.25
Hematites No. 1 non-Bessemer	3.25
No 1. Specular, Non-Bessemer	$3.75@ 4.15

PIG IRON.

CLEVELAND (f. o. b. cars):

Bessemer	$14 00@$14 25
No. 1 Strong Foundry	14 25@ 14 50
No. 2 Strong Foundry	13 25@ 13 50
No. 1 Grey Forge, red short	12 35@ 12 50
No. 2 Gray Forge, neutral	12 25@ 00 00
No. 1 American Scotch	14 50@ 00 00
No. 2 American Scotch	13 50@ 00 00
Lake Superior Charcoal	17 00

PITTSBURGH (reported by A. H. Childs):

No. 1 Foundry	$14 00@$14 25
No. 2 Foundry	13 00@ 13 25
Grey Forge	12 25@ 00 00
White and Mottled	11 50@ 11 75
Warm Blast Charcoal	18 00@ 22 00
Cold Blast Charcoal	23 00@ 27 00
Bessemer	14 00@ 14 25

CHICAGO (reported by our representative:)

Lake Superior Charcoal	$16 50@$17 00
Local Coke Foundry No. 1	13 75@ 14 25
Local Coke Foundry No. 2	13 00@ 13 50
Local Coke Foundry No. 3	13 00@ 13 25
Local Scotch Foundry No. 1	14 00@ 15 00
Local Scotch Foundry No. 2	13 50@ 14 00
Local Scotch Foundry No. 3	13 00@ 13 50
Southern Coke No. 1	14 85@ 15 00
Southern Coke No. 2	13 35@ 13 60
Southern Coke No. 3	12 85@ 13 10
Southern No. 1 Soft	13 35@ 13 60
Southern No. 2 Soft	12 85@ 13 10
Ohio Silveries No. 1	16 50@ 17 00
Ohio Silveries No. 2	16 25@ 16 75
Ohio Strong Softeners No. 1	16 50@ 17 00
Ohio Strong Softeners No. 2	15 50@ 16 00
Tennessee Charcoal	16 50@ 17 00
Alabama Car Wheel	18 85@ 19 85

CINCINNATI (reported by Hyatt, Mathews & Co.):

Southern Coke No. 1, Foundry	$13 25@$13 50
Southern Coke No. 2 and No 1 Soft	12 25@ 12 50
Southern Coke No. 3	11 75@ 12 00
Ohio Soft Stone Coal No. 1	16 00@ 16 50
Mahoning Valley No. 1	15 50@ 16 00
Mahoning Valley No. 2	14 50@ 15 00
Hanging Rock Charcoal No. 1, Fdy	18 25@ 18 50
Hanging Rock Charcoal No. 2, Fdy	17 25@ 17 50
Alabama Charcoal No. 1	16 00@ 16 50
Standard Southern Coke, Grey Forge	11 00@ 11 25
Mottled Neutral Coke	10 75@ 11 00
High Grade Virginia Coke Iron No. 1	16 00@ 16 25
High Grade Virginia Coke Iron No. 2	15 00@ 15 25
Southern Car Wheel Iron	17 00@ 17 50
Lake Superior Car Wheel & Malleable	17 50@ 18 00

BUFFALO (reported by Rogers, Brown & Co.)

Mahoning and Shenango Valley, strong, No. 1 Foundry	$15 50
Mahoning and Shenango Valley, strong, No. 2 Foundry	13 75
Ohio Softener No. 1	14 50
Ohio Softener No. 2	14 00
Jackson Co. Silvery, No. 1	$17 00@ 17 30
Jackson Co. Silvery No. 2	16 30@ 16 80
Lake Superior Charcoal	17 25
Tennessee Charcoal	18 00
Southern Softener No. 1	13 90@ 14 00
Alabama Car Wheel	19 00
Hanging Rock Charcoal	20 50

LOUISVILLE (reported by Hall Bros. & Co.):

Southern Coke No. 1	$13 00@$13 25
Southern Coke No. 2	12 00@ 12 25
Southern Coke No. 3	11 25@ 11 50
Southern Charcoal No. 1	15 50@ 16 00
Southern Charcoal No. 2	15 00@ 15 50
Missouri Charcoal No. 1	17 00@ 17 50
Missouri Charcoal No. 2	16 50@ 17 00
Neutral Coke	11 50@ 12 00
Mottled	10 50@ 10 75
Southern (standard brands)	17 50@ 18 50
Southern (other brands)	16 50@ 17 00
Lake Superior	18 00@ 18 50

ST. LOUIS (reported by Rogers, Brown & Meacham):

Southern Coke No 1	$13 75@$14 00
Southern Coke No. 2	12 50@ 12 75
Southern Coke No. 3	12 25@ 12 50
Southern Grey Forge	11 50@ 11 75
Southern Charcoal No. 1	15 50@ 16 00
Missouri Charcoal No. 1	14 00@ 14 50
Ohio Softeners	16 50@ 17 00
Lake Superior	17 50@ 18 00
Southern	18 25@ 18 50
Connellsville Coke, St. Louis	5 65

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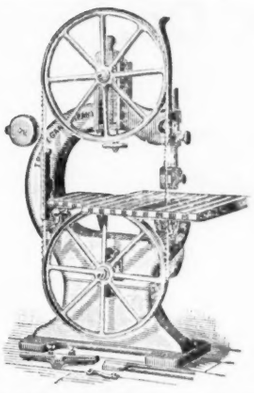

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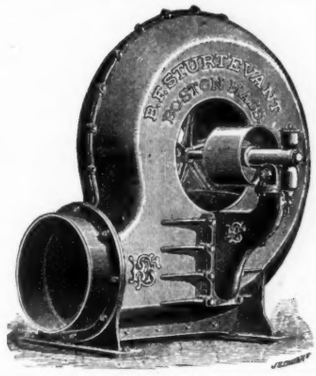

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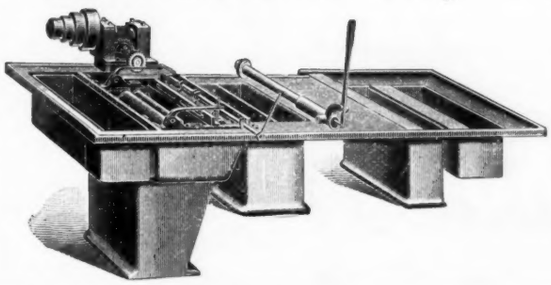

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No. 25 Press.

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FOR BAR AND SHEET METALS. DIES FOR ALL KINDS OF WORK.

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DETROIT (reported by William F. Jarvis & Co.)

Lake Superior Charcoal, all numbers	$16 50@$17 00
Lake Superior (coke) Bessemer	15 00@ 15 50
Lake Superior Coke, Foundry, all ore	15 50@ 16 00
Standard Ohio Black Band	15 50@ 16 00
Southern No. 1	14 00@ 14 50
Southern Grey Forge	12 50@ 13 00
Jackson County (Ohio) Silvery	17 25@ 17 75

LOUISVILLE (reported by Geo. H. Hull & Co.)

Southern Coke No. 1 Foundry	$13 00@$13 25
Southern Coke No. 2 Foundry	12 00@ 12 25
Southern Coke No. 3 Foundry	11 00@ 11 25
Grey Forge	10 75@ 11 00
Spathite	13 25
Southern Charcoal No. 1 Foundry	15 00@ 16 00
Car Wheel	17 50@ 17 75

OLD RAILS AND SCRAP METAL.

[Prices paid by mills.]

	Gross Tons
Old iron rails	$19 00
Old steel rails	14 00
	Net Tons
No. 1 R. R. wrought scrap	$15 00
No. 1 wrought scrap	14 50
No. 1 Machine cast scrap	11 00
Iron axles	20 00
Axle turnings	11 05
Wrought turnings (free from cast)	9 50
Cast borings	6 75
Uncut wrought iron boilers	8 25
Steel boiler Plates	12 50
Grate bars	7 00
Pipes and flues (clean)	10 00
Tank iron	10 50
Hoop and band iron	8 00
Sheet iron	7 00
Wrought drillings	8 50
Malleable iron	9 00

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. mill)	1.90c@2.00c
Angles	1.80c@1.90c
Tees	2.30c
Universal Plates	1.80c
Sheared Plates	1.90c

MERCHANT IRON AND STEEL.

Flat Bar.

1½ to 4 by ⅜ to 1 inch	1 65
1½ to 6 by ⅜ to 1 inch	1 70
1¾ to 6 by 1⅛ to 2 inch	1 85
1¼ & 1⅜ by ⅜ to ¾ inch	1 70
1 & 1⅛ by ⅜ to ¾ inch	1 75
⅝, ⅜, ⅞, by ⅜ to ⅝ inch	1 85

Round and Square.

1 to 1⅞ inch	1 65
2 to 2⅝ inch	1 75
2¾ to 3¼ inch	1 90
3⅜ to 4 inch	2 15
4¼ to 4½ inch	2 75
4¾ to 5 inch	3 00

Oval.

⅞ to 1¼ inch	1 85
⅝ to ¾ inch	1 85
½	2 05
⅜	2 25

Half Oval and Half Round.

1½ to 3 inch	2 20
⅞ to 1½ inch	2 00
⅝ to ¾ inch	2 25
½	2 40
⅜	3 50

Heavy Band.

1¼ to 6 by ¼ and 5-16 inch	1 75
1 to 1⅜ by ¼ and 5-16 inch	1 80
¾ to ⅞ by ¼ and 5-16 inch	1 90
½ to ⅝ by ¼ and 5-16 inch	2 15

Hoops.

1¼ to 4, Nos. 13 to 15	2 40
1¼ to 2, Nos. 16 to 18	2 45
1¼ to 2, No. 19	2 50
1¼ to 2, No. 20	2 50
1¼ to 2, No. 21	2 60
1¼ to 2, No. 22	2 70
15-16, 1 and 1⅛, Nos. 13 to 15	2 45
15-16, 1 and 1⅛, Nos. 16 to 18	2 50
15-16, 1 and 1⅛, Nos, 19 and 20	2 60
15-16, 1 and 1⅛, No, 21	2 70
15-16, 1 and 1⅛, No. 22	2 80
⅞, Nos. 13 to 15	2 60
⅞, Nos. 16 to 18	2 70
⅞, Nos. 19 and 20	2 80
⅞, No. 21	2 50
⅞, No. 22	3 00
13-16, Nos. 13 to 15	2 70
13-16, Nos. 16 to 18	2 80
13-16, Nos. 19 and 20	2 90
13-16 No. 21	3 00
13-16, No. 22	3 10
¾, Nos, 13 to 15	2 80
¾, Nos. 16 to 18	2 95
¾, Nos. 19 and 20	3 00
¾, No. 21	3 10
¾, No. 22	3 25
11-16, Nos. 13 to 15	3 05
11-16, Nos 16 to 18	3 10
11-16, Nos. 19 and 22	3 20
11-16, No. 21	3 30
11-16, No. 22	3 40
⅝, Nos. 13 to 15	3 10
⅝, Nos. 16 to 18	3 20
⅝, Nos. 19 and 20	3 30
⅝, No. 21	3 40
⅝, No. 22	3 50
⅝, No. 23	3 60

Light Band.

1½ to 6 by ⅛ to 3-16 inch	1 95
1½ to 6 by Nos. 11 and 12	2 00
1 to 1⅜ by ⅛ to 3-16 inch	2 00
1 to 1⅜ by Nos. 11 and 12	2 05
⅞ and 13-16 by ⅛ to 3-16 inch	2 15
⅞ and 13-16 by Nos. 11 and 12	2 20

Brainard Milling Machine Co.

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Six Sizes of Upright and Horizontal Plain MILLING MACHINES.

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FOR SALE BY THE
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¾ and 11-16 by ⅛ to 3-16 inch	2 25
¾ and 11-16 by Nos. 11 and 12	2 30
⅝ and 9-16 by ⅛ to 3-16 inch	2 40
⅝ and 9-16 by Nos. 11 and 12	2 45
½ by ⅜ to 3-16 inch	2 55
¼ by Nos. 11 and 12	2 60

Wagon Box Iron.

⅞ inch, beveled edge, by Nos. 11 and 12	2 20
⅞ inch, " " " " 13 and 14	2 30
¾ inch, " " " " 11 and 12	2 35
¾ inch, " " " " 13 and 14	2 55

Sheet Iron.

No. 10 to 14	2 30
No. 15 to 17	2 45
No. 18 to 21	2 60
No. 22 to 24	2 70
No. 25 to 26	2 80
No. 27	2 90
No. 28	3 55

Iron Boiler Plates.

Tank, ¼ inch and heavier	2 25
C No. 1, " "	2 40
C H No. 1, " "	2 50
C H Flange, " "	3 50
Extra Flange "	4 00
Solid Fire Box "	4 75

Steel Boiler Plates—1-4 in. and Heavier.

Tank	2 25
Shell	2 50
Flange	2 75
Marine Flange	3 00
Fire Box	4 00

Above includes plates 90 inches wide.

90 to 96 in. wide	½c. lb. extra
96 to 100 in. wide	1 c. "
100 to 104 in. wide	1½c. "
104 to 116 in. wide	special

American Cast Tool Steel.

ROUND, SQUARE AND OCTAGON.	cts. lbs.
1 to 2 in. inclusive	08
9-16 to ½ in. "	08½
7-16 to ⅜ and 2⅜ to 3 in.	09
3⅛ to 4 in.	09½
⅝ to 11-16 and 4½	10
⅛ to 6 in.	10½
¼ to 9-32 and 6⅛ to 7 in.	11
3-16 in	13

Flats.

	cts. lbs.
2 to 9-16 in. wide by 2 to ⅝ thick	8

Bessemer and O. H. Steel.

Machinery	base price, 2 35
Tire	" 2 25
Spring	" 2 80
Sleigh Shoe	" 2 50
Toe Calk	" 2 35
Cutter Shoes, tapered and bent	" 2 75

English Tool Steel.

Jessop's	15½c
Hobson's "Best"	15½c
" "Choice"	35c

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	4 00
Bridge ½, ⅝, 11-16 and ¾ inch diam	4 00

MACHINERY SUPPLY MARKET.

Anvils.

American	℔ lb 9@10
Wright's	℔ lb 12

Bellows.

Blacksmiths' Hill's	dis 40
Blacksmiths' Bullock's	dis 50&10
Moulders'	dis 40@40&10
Hand	dis 40&10@50

Belting.

Boston Belting Co.'s standard	dis 70
" " " extra	dis 60&5
" " " best	dis 55
Cleveland Rubber Co. extra standard	dis 60&10
Hoyt's Short Lap	dis 45
Shultz Raw Hide Leather Belting, single	dis 40
Munson's Short Lap Single Leather	dis 45
Munson's Short Lap Double and Light Double Leather	dis 50
Shultz Raw Hide Leather Belting, Double and Light Double	dis 40
Standard, oak tanned	dis 50&10
Alexander Brothers' pure oak tanned	dis 45

Blowers and Exhausters.

B. F. Sturtevant's	dis 20
Boston Blower Co.	dis 35
Buffalo	dis 40

Chucks.

Cushman's 4 Jaw Independent	dis 45
" Combination	dis 40
" Geared Scroll	dis 30
" 2 Jaw Brass Workers	dis 30
" Drill	dis 35
Wescott's Scroll Combination	dis 33⅓
" Independent	dis 40
" Little Giant Drill	dis 30
Horton's Universal	dis 40
" Independent	dis 45
Whiton's Independent	dis 45
National Combination	dis 40
Sweetland "	dis 40
Almond Drill	dis 20
Morse "	dis 15
Skinner's Combination Lathe	dis 40&10
" Independent Lathe	dis 40&10
" Universal Lathe	dis 40&10
" Drill	dis 35

Cutters and Reamers.

Cleveland	dis 10@15
Pratt & Whitney	dis 10@15
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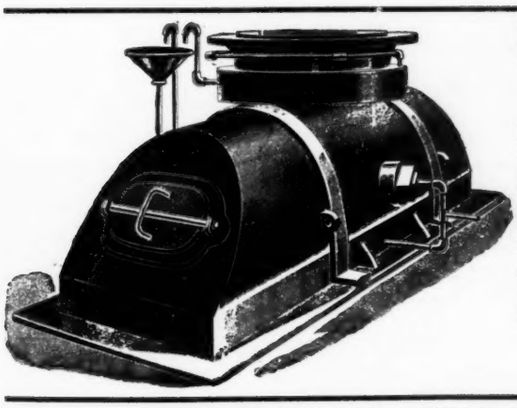

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Nicholson.....dis 60&10@60&10&10
" X. F.....dis 25
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Black Diamond.....dis 60&10@60&10&10
McClellan.....dis 60&10@60&10&10
Disston's.....dis 65@70
Western.....dis 70
Stub's.....dis 25
Grobet's.....dis 30
Reynolds Bros.' Hand Cut.....dis 50
Industry File Works, Hand Cut.....dis 50

Hammers.

P. S. W.....dis 40
Atha new list, Jan. 15, 1887.....dis 50
Heavy hammers and sledges under 5 lbs.....15c
" " " " over 5 lbs.....12c

Jack Screws.

Illinois Bolt Co. list.....dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4¾	4	3¾	3½
Hexagon	15½	11½	8½	6	5¾	5¼	5
Washers	9	8	7	5	4½	4½	4½

In lots less than 100 lbs, ₩ lb add ½c., 1 lb boxes add 1c to list.

Nails (wire).

List July 14, 1887.....dis 75
Standard Penny Nails, ₩ keg card rate
{ Car lots.....$1.50
{ Less than car lots...$1.60

Oilers.

Zinc and Tin.....dis 60
Brass and Copper.....dis 50
Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ₩ doz.....dis 10@10&10

Packing, Steam.

Boston Belting Co.....dis 60
American Packing Hemp.....₩ lb 9@10
Russia " " .....₩ lb 14
Italian " " .....₩ lb 13@19
Plumbago Piston.....₩ lb 40
Peerless.....₩ lb 60
Morrison's " .....₩ lb 50
Square Flax " .....₩ lb 50
Sheet Rubber.....₩ lb 12&24
Excelsior Rubber.....₩ lb 48
Rainbow.....{ Full Rolls.....50c ₩ lb
{ Less than Full Rolls, 60c ₩ lb
Eclipse Gasket.....₩ lb 75

Picks.

Railroads, 5 to 6 lbs.....$12 dis 60
" 6 to 7 lbs.....$13 dis 60

Pulleys.

Iron Pulleys, Walker List.....dis 40
Medart Pulleys.....dis 50
Split Wood Pulleys.....dis 50@55

Rivets.

Iron, Thousand, list November 17.....dis 50@50&10
Iron, Ordinary, Cooper's Block and Carriage list November 17.....dis 50@50&10
Copper.....dis 50@50&10

Saws.

Disston's Circular.....dis 40&10
" Band.....dis 25
" Scroll.....Net
Hack Saw Stubs.....dis 20
" " Eureka.....dis 20
" " Star.....dis 20
Saw Swages Diston's.....dis 30
Atkins' Circular Saws.....dis 40&45
" Mill, Mulay and Drag Saws.....dis 40&10
" Wood Saws.....dis 40&10
" Silver Steel Diamond Cross-cut Saws.....70c per ft
" Dexter Cross-cuts.....50c "
" Diamond " .....30c "
" Tuttle Tooth Cross-cuts.....25c "
" One-man Cross-cuts.....32c "

No. 1 Handles	23c per pair
No. 6 "	16c "
Excelsior Saw Tools	$6 per doz
Perfection "	$15 "
Detroit Saw Works, Circular	dis 50
" " " Band	dis 25
" " " Mulay	dis 45

Taps.

Cards, Hand and Nut to 2 in	dis 50
Carpenters' " " "	dis 50
Morse " " "	dis 50
Pratt & Whitney " " new list	dis 10
Machine Screw Taps	dis 55
Pipe Taps to 2½ in	dis 70
Stay Bolt Taps	dis 25
Stove Bolt Taps	dis 55
Pulley Taps	dis 40

Vises.

Solid Box	dis 60
Parker's	dis 20@25
Prentiss	dis 20
Stephen's	dis 25@30
Barrett's	dis 30
Miller's Falls	dis 40
Merrill's	dis 15@20
Howard	dis 35

Wire.

New List, Jan. 18, 1884

Brass	dis 30
Copper	dis 40
Bright and annealed, Nos. 0@18	dis 70&10@75
" " Nos. 19@26	dis 75@75& 5
" " Nos. 27@36	dis 75&10& 5
Coppered Nos. 0 to 18, market list	dis 70@70& 5
Galvanized Nos. 0 to 18 " "	dis65& 5
Tinned market Nos. 0 to 18	dis 67½
Cast steel	dis 50
Tinned Broom Wire	dis 70&5@70&10
Annealed Fence, Nos. 8 and 9	dis 75
Annealed Grape, Nos. 10 to 14	dis 75
Stub's Steel Wire regular	95c ₱ lb dis 30

Wrenches.

Coe's genuine	dis 50
Girard Standard	dis 70&10
Agricultural	dis 75&10
Mechanic's	dis 55&10& 5
Bemis & Call's Combination	dis 35
Donohue's Engineers	dis 20&10
Lamson & Sessions Engineers	dis 60
Billings & Spencer's Drop Forged	dis 25
William's " "	dis 25
Alligator " "	dis 40

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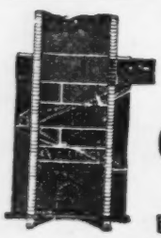

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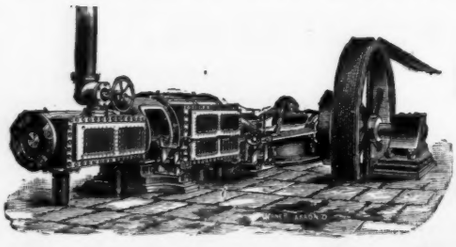

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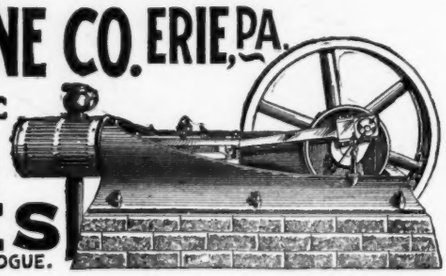

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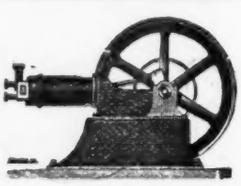

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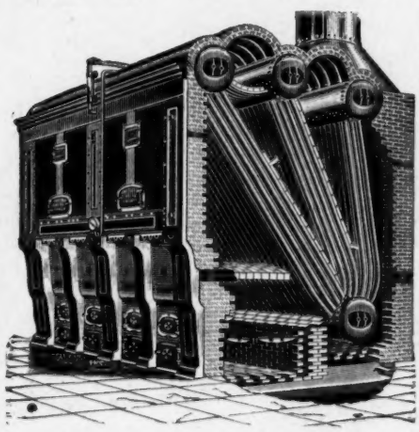

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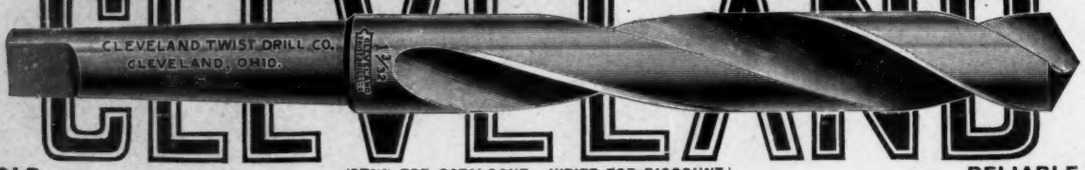

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